MAR 14 1944

# ENGINEERING NEWS-RECORD

MARCH 9, 1944

Reinforced concrete arch culvert on a Kansas highway. A simplified method of computing quantities in these culverts is outlined on page 116.

## FORD'S AMAZON BASIN PROJECT

By Edward J. Cleary

# THAT BRIDGE OF TOMORROW CAN BE *planned* TODAY

As a highway or municipal engineer you have a double responsibility. Not only will you want to make your plans to provide jobs for returning service men and war workers, but these plans must fit a postwar world, the pattern of which is not yet clear.

You can find a practical answer to your postwar bridge problems on both of these counts by specifying ARMCO Multi Plate Pipe and Arches. This way you get a strong, durable, basic structure that can be easily installed by unskilled labor. At the same time you assure a flexibility in design and appearance that will enable you to conform to postwar standards. With ARMCO Multi Plate to support the load you can finish the bridge with any type of design and material you choose.

Other advantages include ease of transportation, quick assembly on the job site without special equipment, and freedom from maintenance.

Include ARMCO Multi Plate in your postwar plans even though you may not be able to get it for your immediate construction needs. After the war it will again be available for bridges, stream enclosures, large sewers and special drainage structures. Write us for complete data. Armco Drainage Products Assn., 35 Curtis St., Middletown, O.

ARMCO

**MULTI PLATE PIPE AND ARCHES**

# CONSTRUCTION TRENDS

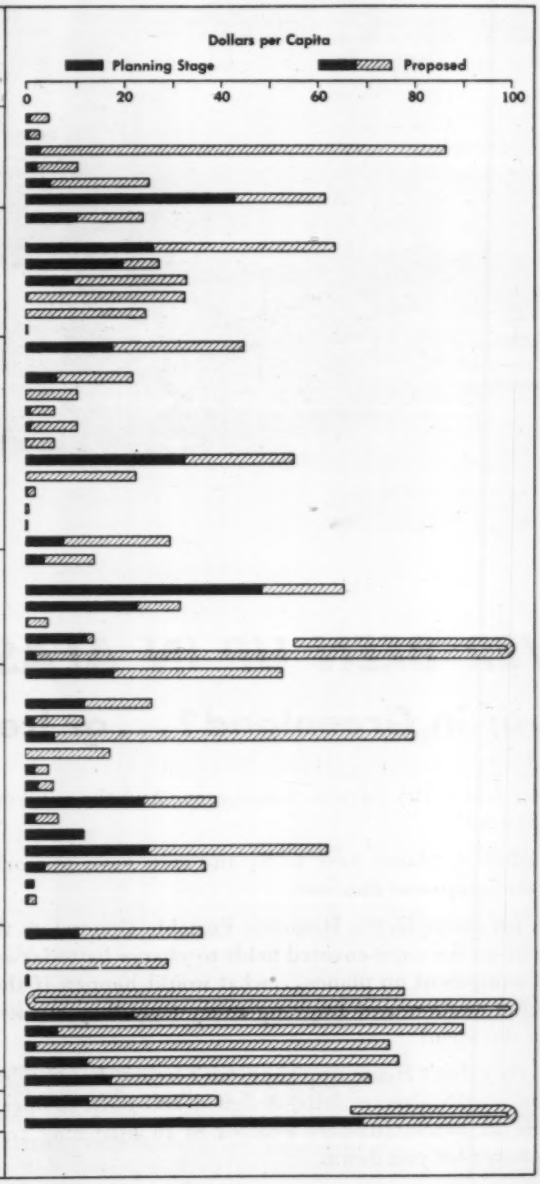
*Notes on significant movements in the construction industry*

## Postwar Planning Progress—By States

### Total 1943 Volume of Proposed Projects and Plans Started as Reported to *ENR*

Totals are Thousands of Dollars—000 omitted

| | *Total Proposed Volume* | *Proposed Volume $ per Capita* | *Total in Planning Stage* | *Planning Stage, $ per Capita* | *Planning Stage % of Proposed* |
|---|---|---|---|---|---|
| Maine | 3,922 | 4.6 | 400 | 0.5 | 10.2 |
| New Hampshire | 1,328 | 2.7 | 150 | 0.3 | 10.3 |
| Vermont | 30,820 | 86.0 | 820 | 2.3 | 2.7 |
| Massachusetts | 43,458 | 10.1 | 8,248 | 1.9 | 19.0 |
| Rhode Island | 17,784 | 25.0 | 3,379 | 4.7 | 19.0 |
| Connecticut | 104,171 | 61.0 | 72,578 | 42.5 | 69.7 |
| **New England** | **201,483** | **23.9** | **85,575** | **10.1** | **42.6** |
| New York | 852,681 | 63.3 | 343,092 | 25.4 | 40.3 |
| New Jersey | 113,108 | 27.2 | 82,296 | 19.8 | 72.8 |
| Pennsylvania | 322,672 | 32.6 | 96,092 | 9.7 | 29.8 |
| Maryland | 58,819 | 32.3 | 100 | 0.1 | 0.2 |
| Dist. of Columbia | 16,323 | 24.6 | — | — | — |
| Delaware | 25 | 0.1 | — | — | — |
| **Middle Atlantic** | **1,363,628** | **45.0** | **521,580** | **17.2** | **38.2** |
| Virginia | 57,583 | 21.5 | 16,121 | 6.0 | 28.0 |
| West Virginia | 19,500 | 10.3 | — | — | — |
| North Carolina | 19,507 | 5.5 | 2,725 | 0.8 | 14.0 |
| South Carolina | 19,387 | 10.2 | 1,560 | 0.8 | 8.1 |
| Georgia | 17,250 | 5.5 | — | — | — |
| Florida | 104,810 | 55.3 | 61,201 | 32.3 | 58.4 |
| Alabama | 63,375 | 22.4 | — | — | — |
| Mississippi | 3,688 | 1.7 | 150 | 0.1 | 4.1 |
| Louisiana | 515 | 0.2 | 25 | * | 4.9 |
| Kentucky | 400 | 0.1 | — | — | — |
| Tennessee | 86,917 | 29.8 | 21,456 | 7.4 | 24.7 |
| **South** | **392,932** | **13.9** | **103,238** | **3.7** | **26.3** |
| Ohio | 449,612 | 65.0 | 336,173 | 48.7 | 75.0 |
| Indiana | 108,252 | 31.6 | 77,851 | 22.7 | 72.0 |
| Illinois | 33,344 | 4.2 | 1,625 | 0.2 | 4.9 |
| Wisconsin | 43,486 | 13.8 | 38,177 | 12.2 | 88.0 |
| Michigan | 755,118 | 143.7 | 9,620 | 1.8 | 1.3 |
| **Middle West** | **1,389,812** | **52.2** | **463,446** | **17.4** | **33.3** |
| Minnesota | 71,353 | 25.6 | 31,365 | 11.2 | 44.0 |
| Iowa | 29,741 | 11.7 | 3,359 | 1.3 | 11.3 |
| Missouri | 298,338 | 78.9 | 21,332 | 5.6 | 7.1 |
| Arkansas | 31,893 | 16.4 | 25 | — | 0.1 |
| North Dakota | 2,730 | 4.3 | 690 | 1.1 | 25.3 |
| South Dakota | 3,439 | 5.4 | 1,340 | 2.1 | 39.0 |
| Nebraska | 50,789 | 38.6 | 30,902 | 23.5 | 60.9 |
| Kansas | 11,365 | 6.3 | 2,765 | 1.5 | 24.4 |
| Oklahoma | 27,425 | 11.8 | 26,975 | 11.6 | 98.3 |
| Texas | 396,097 | 61.8 | 159,094 | 24.8 | 40.2 |
| Montana | 20,183 | 36.1 | 2,150 | 3.8 | 10.7 |
| Wyoming | 245 | 1.0 | — | — | — |
| Colorado | 1,800 | 1.6 | 300 | 0.3 | 16.7 |
| New Mexico | — | — | — | — | — |
| **West of Miss.** | **945,397** | **35.4** | **280,297** | **10.5** | **29.7** |
| Idaho | 15,100 | 28.8 | — | — | — |
| Utah | 352 | 0.6 | 322 | 0.6 | 91.6 |
| Arizona | — | — | — | — | — |
| Nevada | 30,495 | 277.5 | 2,350 | 21.4 | 77.1 |
| Washington | 155,474 | 89.6 | 104,337 | 6.0 | 67.2 |
| Oregon | 81,229 | 74.6 | 1,486 | 1.4 | 1.8 |
| California | 525,184 | 76.0 | 85,329 | 12.3 | 16.2 |
| **Far West** | **807,834** | **70.7** | **193,824** | **17.0** | **24.0** |
| **Total U. S. '43** | **5,101,087** | **38.8** | **1,647,960** | **12.5** | **32.3** |
| **Canada** | **1,529,573** | **133.8** | **783,047** | **68.6** | **51.2** |

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# EVER BEEN UP IN ALASKA?

## ... or in Greenland? ... or Iceland?

Thirty, forty, fifty degrees *below* zero. And the wind cuts through you like a knife.

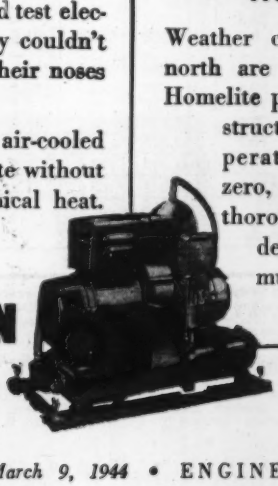
Nevertheless, planes have to fly and men have to work... *and so does the equipment they use.*

Take, for example, the Homelite Portable Generators that are carried out on the snow-covered fields to charge batteries and test electrical equipment on planes... what would happen if they couldn't stand the weather and froze up every time they stuck their noses out in the open?

Well, they don't freeze up. They *can't* freeze. For they're air-cooled gasoline-engine-driven units, designed and built to operate without trouble in brutal sub-zero weather or in blistering tropical heat. They never let you down.

### How We Do It

Weather conditions of the frozen north are duplicated right in the Homelite plant. In a specially constructed room, where the temperature is kept far below zero, Homelite units undergo thorough performance tests under the same conditions that must be faced in the Arctic.



**HOMELITE CORPORATION**

PORT CHESTER, NEW YORK

# ENGINEERING NEWS-RECORD

...ted to Buildings, Sewers, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Shipbuilding, Irrigation, Canals, Railroads

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WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Manager*

... 132 MARCH 9, 1944 No. 10


## ...OMING NEXT

...rveys and savages might well be ... title of an article to appear in ... 23 issue describing the work of ... Brazilian Commission for Frontier ...aracation. Exploring and map... the northern jungle borders of ...il, much territory of which is ...bited by Indians who have never ... a white man, is one of the most ...enturesome jobs in the world for ...rveyor. Dr. Luiz de Souza Mar... assistant to the commission's ...f of operations, tells a story that ...y North American engineer will ...t to read.

...onversion of a ten-lane fixed ...ge, largest of 19 spans over Chi... ...s Sanitary and Ship Canal, into ...3-ft. vertical lift span—to pass ... craft on the Great Lakes-to-Gulf ...erway—is an achievement which ...rits attention. The construction ...y behind this project is one of a ...ntless fight against time and the ...ments, an example of American ...ineer ingenuity at work.

...Many factors contribute to the fail... of concrete highway pavements, ... it is believed that the most criti... failure today is caused by "slab ...mping." Heavy axle loads, "free" ...er under the slab, and unsuitable ...grade soil are contributing fac... to "pumping" joints. How Mis...ri highway engineers have restored ...dreds of miles of badly cracked ...crete pavement by a combination ... mud-jacking and "decking" will ... described in the Mar. 23 issue.

## ...OOKING AHEAD

...GROUND DEWATERING FOR CON...UCTION—is the general title of ... articles scheduled for the month ...April. Part I, to appear on April 6, ...l cover the historical background ...d development of subsurface de...tering procedure. Part II, in the ...ril 20 issue, will outline a criteria ... selection of drainage methods and ...scribe for the first time the newly ...eloped process of installing hori...tal wells, using as an example its ...plication to the Brooklyn-Battery ...icular tunnel in New York. These ...icles should contribute much to... ...rd bringing data on subsurface ...watering up-to-date.


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**CHANGE OF ADDRESS**

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The new Inland Hi-Bond reinforcing bars in a complete range of sizes are now available from Ryerson stock. The scientific design of this new bar with its reversed double helical ribs provides vastly greater anchorage and bonding strength in keeping with the development of higher strength concrete. We believe the Hi-Bond bar will effect many improvements and economies for the construction industry.

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# RYERSON
## REINFORCING-SERVICE

# MONTHLY CONSTRUCTION BUSINESS SUMMARY

## ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

| (000 omitted) | February 1943 (4 wk.) | February 1944 (4 wk.) | % Change | Two Months 1943 (8 wk.) | Two Months 1944 (8 wk.) | % Change |
|---|---|---|---|---|---|---|
| ntinental U. S. Construction | $306,242 | $117,878 | −62.0 | $533,068 | $274,396 | −48.0 |
| vate Construction | 36,561 | 28,875 | −21.0 | 52,059 | 53,231 | +2.0 |
| blic Construction | 269,681 | 89,003 | −67.0 | 481,009 | 221,165 | −54.0 |
| deral | 264,884 | 81,576 | −69.0 | 464,140 | 206,173 | −56.0 |
| al New Productive Capital | $11,041 | $11,629 | +5.0 | $15,539 | $158,801 | +922.0 |
| vate Investment | 11,041 | 10,129 | −8.0 | 14,039 | 62,394 | +344.0 |
| deral (non-federal work) | ..... | 1,500 | ..... | 1,500 | 5,575 | +272.0 |
| deral (federal work) | ..... | ..... | ..... | ..... | 90,832 | ..... |
| N R Construction Volume Index, 913 = 100 | 231 | 86 | −63.0 | 202* | 100* | −50.5 |

* *Two-month average.*

## NSTRUCTION COSTS . . . WAGE RATES . . . MATERIAL PRICES

| | March 1943 | March 1944 | % Change | Changes February to March 1943 Feb. | 1943 Mar. | 1943 % | 1944 Feb. | 1944 Mar. | 1944 % |
|---|---|---|---|---|---|---|---|---|---|
| N R Construction Cost dex, 1913 = 100* | 285.24 | 295.34 | +3.5 | 283.48 | 285.24 | +0.6 | 295.05 | 295.34 | +0.1 |
| N R Building Cost Index, 913 = 100‡ | 226.66 | 232.32 | +2.5 | 226.90 | 226.66 | −0.1 | 232.03 | 232.32 | +0.1 |

‡ *Does not reflect increased costs due to more overtime, lower labor efficiency, delivery delays, etc.*

### ENR 20-CITIES' AVERAGE

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| mmon Labor | $0.842 | $0.870 | +3.3 | $0.832 | $0.842 | +1.2 | $0.869 | $0.870 | +0.1 |
| ed Labor (av. 3 trades) | 1.606 | 1.623 | +1.1 | 1.606 | 1.606 | 0 | 1.620 | 1.623 | +0.2 |
| cklayers | 1.700 | 1.715 | +0.9 | 1.700 | 1.700 | 0 | 1.715 | 1.715 | 0 |
| uctural Ironworkers | 1.661 | 1.680 | +1.1 | 1.661 | 1.661 | 0 | 1.673 | 1.680 | +0.4 |
| rpenters | 1.457 | 1.473 | +1.1 | 1.457 | 1.457 | 0 | 1.472 | 1.473 | +0.1 |
| ment, per bbl | $2.61 | $2.62 | +0.4 | $2.60 | $2.61 | +0.4 | $2.62 | $2.62 | 0 |
| forcing steel, cwt | 2.74 | 2.79 | +1.8 | 2.70 | 2.74 | +1.5 | 2.79 | 2.79 | 0 |
| uctural steel, base | 2.10 | 2.10 | 0 | 2.10 | 2.10 | 0 | 2.10 | 2.10 | 0 |
| d, per ton | 1.21 | 1.23 | +1.7 | 1.21 | 1.21 | 0 | 1.23 | 1.23 | 0 |
| mber, 2x4 Fir, per M ft | 51.05 | 53.45 | +4.7 | 51.47 | 51.05 | −0.8 | 53.45 | 53.45 | 0 |
| mber, 2x4 Pine, per M ft | 44.01 | 49.88 | +13.3 | 44.03 | 44.01 | ** | 49.71 | 49.88 | +0.3 |
| ck, common, per M | 15.66 | 16.20 | +3.4 | 15.66 | 15.66 | 0 | 16.20 | 16.20 | 0 |
| dy-mixed concrete, c.y | 7.39 | 7.42 | +0.4 | 7.39 | 7.39 | 0 | 7.42 | 7.42 | 0 |
| et. clay tile, 3x12x12-in. | 78.93 | 79.34 | +0.5 | 78.93 | 78.93 | 0 | 79.34 | 79.34 | 0 |
| ing asphalt, cars, ton | 15.12 | 15.25 | +0.9 | 14.88 | 15.12 | +1.6 | 15.25 | 15.25 | 0 |

** *Less than .05 percent change.*

## MATERIAL SHIPMENTS . . . . BUILDING PERMITS

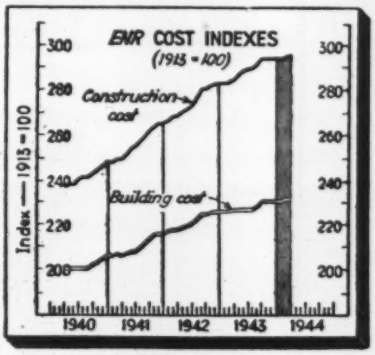
| | February 1943 | February 1944 | % Change | Jan 1944 | % Change Jan.-Feb. |
|---|---|---|---|---|---|
| eel (% operating capacity) A. I. S. I | 98.1 | 97.4 | −0.7 | 95.6r | +1.9 |

| | January 1943 | January 1944 | % Change | Dec. 1943 | Jan. 1944 | % Change |
|---|---|---|---|---|---|---|
| bricated structural steel, tons, A. I. S. C. | 91,889† | 26,772† | −70.9 | 39,633† | 26,772† | −32.5 |
| ment, thous. bbl., U. S. B. of M | 8,641 | 5,040 | −41.6 | 5,603 | 5,040 | −10.1 |
| ilding permits, 215 cities, Dun & Brad-reet (.000 omitted) | $28,819 | $33,711 | +17.0 | $42,393 | $33,711 | −20.5 |

r—*Revised.* †*Bridge and building steel shipments reported to A. I. S. C.*

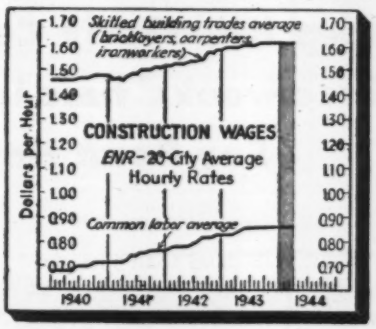
## COST OF LIVING INDEXES . . . EMPLOYMENT

| | January 1943 | January 1944 | % Change | Dec. 1943 | % Change Dec.-Jan. |
|---|---|---|---|---|---|
| st of Living Index, N. I. C. B | 101.5 | 103.9 | +2.4 | 103.9 | 0 |
| st (Housing) Index, N. I. C. B | 90.8 | 90.8 | 0 | 90.8 | 0 |
| tal Employment (est.), thous., B. L. S | 37,862 | 37,229 | −1.6 | 38,478 | −3.2 |
| nstr. Employment (est.), thous., B. L. S | 1,470 | 677 | −53.9 | 773 | −12.3 |




## ENR INDEX NUMBERS

| Base — 100 | Construction Cost 1913 | Construction Cost 1926 | Building Cost 1926 | Building Cost 1926 | Volume '13 | Volume '26 |
|---|---|---|---|---|---|---|
| Mar., 1944 | 295.34 | 141.97 | 232.32 | 125.59 | ... | ... |
| Feb., 1944 | 295.05 | 141.83 | 232.03 | 125.43 | 86 | 38 |
| Jan., 1944 | 294.57 | 141.60 | 231.55 | 125.17 | 114 | 50 |
| Dec., 1943 | 294.51 | 141.57 | 231.49 | 125.14 | 103 | 45 |
| Nov., 1943 | 294.41 | 141.52 | 231.39 | 125.08 | 149 | 65 |
| Oct., 1943 | 294.31 | 141.47 | 231.29 | 125.03 | 142 | 62 |
| Sept., 1943 | 294.09 | 141.37 | 231.20 | 124.98 | 155 | 68 |
| Aug., 1943 | 291.38 | 140.07 | 228.49 | 123.51 | 119 | 52 |
| July, 1943 | 289.92 | 139.36 | 227.89 | 123.19 | 175 | 77 |
| June, 1943 | 289.94 | 139.37 | 227.71 | 123.09 | 204 | 89 |
| May, 1943 | 289.87 | 139.34 | 227.64 | 123.06 | 203 | 89 |
| April, 1943 | 288.80 | 138.83 | 227.50 | 122.98 | 225 | 99 |
| Mar., 1943 | 285.24 | 137.11 | 226.66 | 122.53 | 228 | 100 |
| Feb., 1943 | 283.48 | 136.27 | 226.90 | 122.66 | 231 | 101 |
| Jan., 1943 | 283.45 | 136.25 | 226.87 | 122.64 | 172 | 76 |
| 1943 (Av.) | 289.95 | 139.38 | 228.75 | 123.66 | 176 | 77 |
| 1942 (Av.) | 276.31 | 132.82 | 222.39 | 120.22 | 553 | 243 |
| 1941 (Av.) | 257.84 | 123.95 | 211.46 | 114.32 | 375 | 164 |
| 1940 (Av.) | 241.96 | 116.31 | 202.81 | 109.64 | 269 | 118 |




## ENGINEERING CONSTRUCTION CONTRACTS—ENGINEERING NEWS-RECORD—FEBRUARY, 1944

Engineering News-Record *reports continental U. S. Construction projects of the following minimum cost—waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Four Weeks—Thousands of Dollars (000 Omitted)

| | New England | Middle Atlantic | South | Mid West | West of Mississippi | Far West | United States February 1944 | United States Two Months 1944 | United States Two Months 1943 | Canada |
|---|---|---|---|---|---|---|---|---|---|---|
| **Public Works** | | | | | | | | | | |
| Waterworks | ..... | 183 | 779 | 160 | 1,096 | 660 | 2,878 | 4,296 | 8,352 | 109 |
| Sewerage | 43 | 210 | 453 | 123 | 126 | 406 | 1,361 | 3,598 | 5,092 | 111 |
| Bridges, public | ..... | 154 | 56 | ..... | ..... | 28 | 238 | 976 | 2,906 | ..... |
| Earthwork and waterways | 94 | 190 | 530 | 30 | 894 | 5,409 | 7,147 | 10,262 | 3,256 | ..... |
| Streets and roads | ..... | 248 | 1,361 | 3,629 | 772 | 764 | 6,774 | 11,491 | 22,624 | 862 |
| Buildings, public | 2,536 | 3,789 | 6,682 | 4,959 | 5,725 | 8,528 | 32,219 | 124,138 | 311,436 | 789 |
| Unclassified, public | 1,053 | 22,177 | 6,255 | 2,117 | 3,063 | 3,721 | 38,386 | 66,404 | 127,343 | 450 |
| **tal public** | **3,726** | **26,951** | **16,116** | **11,018** | **11,676** | **19,516** | **89,003** | **221,165** | **481,009** | **2,321** |
| Federal government (included in above classifications) | 3,683 | 26,600 | 14,710 | 7,192 | 11,166 | 18,225 | 81,576 | 206,173 | 464,140 | ..... |
| **Private** | | | | | | | | | | |
| Bridges, private | ..... | 26 | ..... | ..... | ..... | ..... | 26 | 870 | 1,500 | ..... |
| Industrial buildings | 693 | 1,297 | 125 | 2,733 | 10,920 | 178 | 15,946 | 20,400 | 28,121 | 675 |
| Commercial buildings | 301 | 2,675 | ..... | 500 | 2,110 | 5,095 | 10,681 | 29,013 | 18,456 | 150 |
| Unclassified, private | ..... | 25 | 25 | 162 | 2,010 | ..... | 2,222 | 2,948 | 3,982 | ..... |
| **tal private** | **994** | **4,023** | **150** | **3,395** | **15,040** | **5,273** | **28,875** | **53,231** | **52,059** | **825** |
| **tal Engineering Construction** | | | | | | | | | | |
| **bruary, 1944—4 weeks** | **4,720** | **30,974** | **16,266** | **14,413** | **26,716** | **24,789** | **117,878** | ..... | ..... | **3,146** |
| nuary, 1944—4 weeks | 4,306 | 19,536 | 16,774 | 12,336 | 20,496 | 83,070 | 156,518 | ..... | ..... | 1,404 |
| bruary, 1943—4 weeks | 14,638 | 28,850 | 68,562 | 45,453 | 57,036 | 91,703 | 306,242 | ..... | ..... | 5,370 |
| o Months—1944 | 9,026 | 50,510 | 33,040 | 26,749 | 47,212 | 107,859 | ..... | 274,396 | ..... | 4,550 |
| o Months—1943 | 26,917 | 52,320 | 129,079 | 54,341 | 122,359 | 148,052 | ..... | ..... | 533,068 | 14,901 |

# In Time for the Harvest

Processing plant of A. E. Staley Manufacturing Company, Decatur, Ill., completed in time to handle the soy bean harvest because Atlas High-Early cement saved three weeks in construction time. The building, under construction, is shown below. Engineer, Vern E. Alden, Chicago. General Contractor, J. L. Simmons Company, Inc., Decatur, Ill., and Indianapolis, Ind.

## Atlas High-Early Cement saves three weeks' time in completing Soy Bean Flour Mill

THERE WAS more than just construction time and money at stake in the completion of this soy bean processing plant. A. E. Staley Manufacturing Company had to have the mill ready in time to make flour from the 1943 soy bean crop.

Concrete work started July 1. As harvest time was approaching, Atlas High-Early cement was ordered to speed up the concrete work and permit completing the structure on time. E. R. Mullins, project manager for J. L. Simmons Company, Inc., general contractor, estimated that Atlas High-Early saved three weeks' time, thus enabling him to complete the placing of concrete on August 26.

Slip metal pan forms were often removed within 24 hours, Mr. Mullins reports, and concrete made with Atlas High-Early developed strength in three days normally expected in seven.

Other contractors are having the same experience with Atlas High-Early—saving time, saving forms, saving heating and curing time and cost in winter, releasing equipment more quickly for other work.

Before starting your next "rush" job, send for detailed information on Atlas High-Early and for experience records of other jobs. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, New York.

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**OFFICES:** *New York, Chicago, Albany, Boston, Philadelphia, Minneapolis, Duluth, Cleveland, St. Louis, Kansas City, Des Moines, Birmingham, Waco.*

**SAVE TIME IN WARTIME WITH**

# Atlas High-Early Cement

**A UNIVERSAL ATLAS PRODUCT**

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • MARCH 9, 1944 • VOLUME 132 • NUMBER 10

# Concrete specialists review war-period developments

**Consensus at annual meeting of American Concrete Institute is that present knowledge in concrete technique trails its potentialities.**

Two timely subjects—air-entraining mixtures and a review of concrete's important "war babies"—dominated the th annual convention program of e American Concrete Institute in Chigo, Feb. 29 to March 2. A dozen eakers were generally hopeful that e use of air-entraining agents marks real advance in concrete making, but re equally certain that techniques of e are yet to be refined by research.

### Unusual concrete jobs

Of the war achievements, the use of ed concrete tanks for aviation gasone storage and the tremie pouring of ge naval graving docks received the ajor attention. The latter subject (*ENR* Nov. 19, 1942, p. 702, and Mar. 5, 1942, p. 472) was covered in a paper Capt. W. Mack Angus, Lt. Comdr. M. Shanley and Lt. J. A. Erickson, f the Bureau of Yards and Docks, which was presented by Capt. W. H. Smith, now head of the bureau's planning and designing department, but previously public works officer of the yard in which the docks were built. Several papers were devoted to the concrete tank problem, as detailed later in this report.

Fairly well attended for a wartime meeting, most of the convention sessions drew an audience of something over 100, while several times that many were present at a special postwar-theme luncheon on the second day, at which Henry J. Kaiser was the speaker.

### More research needed

Mr. Kaiser emphasized a need for a combination of cooperation and competition among business interests and nations in a world that the airplane has shrunk to one-eighth its prewar size. Research both in product development and market determination will be needed more than ever before, said he.

Following Mr. Kaiser, and focusing his postwar thinking directly on the concrete industry, Frank T. Sheets, of the Portland Cement Association, pointed out how, through research, low-heat cement and now air-entraining cements had been developed to meet special problems; through development studies, he continued, soil-cement roads, grouted stone roadbeds for railroads, and colored concrete were now available to serve engineering needs. "These are merely samples," said Mr. Sheets, "of some of the things that have been done through research and development, which can be duplicated and surpassed in the postwar era if research receives the support that it deserves".

### Officers and prizes

The new president of the A.C.I. is Roy W. Crum, of the Highway Research Board, who succeeds Prof. M. O. Withey, of the University of Wisconsin.

Honorary memberships were conferred upon John J. Earley, wellknown expert in precast, architectural concrete, and upon F. R. McMillan, director of research, Portland Cement Association.

The Leonard C. Wason medals—for the most meritorious paper and for the

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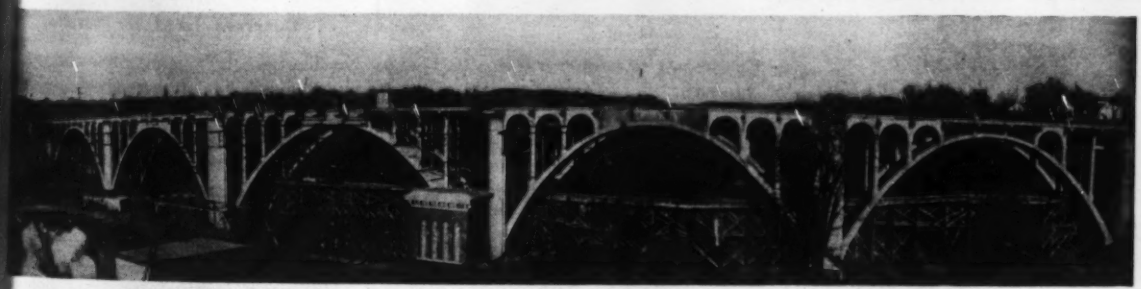

## Rhode Island bridge job, long shut down, soon to be completed

*This summer a highway bridge placed nder construction a decade ago will be comleted across the Blackstone River at Ashton, I. The foundations were built in 1935, and hen the project was shut down for many ears because other work was considered ore imperative.*

*The crossing, which also spans the old lackstone Canal and a line of the New aven R. R., consists of five reinforced concrete arch spans, one of 160 ft. and four of 125 ft. The total length including approaches is 926 ft. A 44-ft. roadway and two 5-ft. sidewalks are provided.*

*When a limited amount of plywood proved to be available, the superstructure contractor reinforced the form panels with metal clips to permit their reuse 18 to 20 times. A 3,000-lb. concrete is being used for the superstructure work.*

*The $450,000 project is being carried out by the division of roads and bridges of the Rhode Island State Public Works Department. George H. Henderson is principal highway engineer, D. O. Cargill, bridge engineer, and Harry C. Kelly, resident engineer.*

*Frederick Snare Corp., New York, did the substructure work. Frank T. Wescott, North Attelboro, Mass., is the superstructure contractor.*

paper reporting the most noteworthy research of the previous year—went to Capt. P. J. Halloran (CEC) U.S.N., and Kenneth M. Talbot, for their paper, "The Properties and Behavior Under Water of Plastic Concrete", and to Prof. Vernon P. Jensen, formerly of the University of Illinois and now stress analyst of the Douglas Aircraft Co., for his paper, "The Plasticity Ratio of Concrete and Its Effect on the Ultimate Strength of Beams".

### Air-entraining agents

The use of air-entraining agents or admixtures in concrete to produce a minute cellular structure, which is reported to make concrete resistant to freezing and thawing, to cracking and to salt scaling, as well as rendering the mix more workable, was described on the program as the "hottest" current subject in concrete.

The excellent session devoted to it did not develop the heat that would be expected from such advance billing, but rather it was instructive and revealing in the widest sense. The subject was introduced in a paper by H. F. Gonnerman (Portland Cement Association), describing an extensive series of tests underway and partly completed in his laboratory, and was followed by brief discussions by about a dozen members, presenting various research and field experience data.

According to Mr. Gonnerman, who used both tallow and vinsol resin as the air-entraining agents, it is not the admixture itself but its efficiency in forming non-connected air voids that is important. Both tallow and vinsol resin were found to be equally good. The tests indicated that air voids in amounts over 5 percent are to be avoided unless the strength of concrete is to be seriously reduced.

These tests also revealed that more air is entrained with less of the agent if the latter is added at the mixer instead of being ground with the clinker. When it is added at the mixer, the agent is first mixed into a sodium hydroxide solution to assure efficient dispersion in the concrete. Reduction in strength of the concrete is the principal disadvantage of air-entraining agents, and can be avoided only by redesigning the mixes, consisting largely of adding more cement and decreasing the amount of the sand.

Describing himself as having the reputation of being against the use of air-entraining agents, F. H. Jackson (Public Roads Administration), said his opposition centered only on their indiscriminate use as a means to cure all of the ills of concrete. These agents do many of the things claimed for them, said Mr. Jackson, but we need to know more about why required quantities of the agents vary with so many variables, and how to keep up the strength of the concrete without destroying the value of the air entrainment. His present view is that a more scientific control can be exercised if the agent is added at the mixer than if it is interground with the cement at the mill. Other discussers and their data and views an air-entraining agents in concrete follow:

*Henry L. Kennedy (Dewey & Almy Chemical Co.)*—The amount of air, not the agent, is important. Sand size is significant because as sand gets smaller, bubbles get smaller and more numerous. Changes in sand sizes, therefore, may change the air content.

*M. A. Swayze (Lone Star Cement Co.)*—Based on ten years' laboratory and field experience, there seems no doubt but that air-entraining agents improve workability and durability and reduce bleeding. Best results are obtained when the vinsol resin is mixed in a solution rather than being interground. All mixes containing air-entraining agents have to be redesigned. Transit-mix practices will have to be revamped to cut down the long agitation period, which increases the amount of air in the mix.

### Field application favored

*Donald MacPherson (Master Builders Research Laboratories)*—It is better to put the agent in the mixer so that the field man can control the mix and its amount of air. Although agents whose only function is to entrain air do reduce the strength of the concrete, there are agents, particularly of the water-soluble, foaming types, as contrasted to the resinous or fatty types, that will entrain air without impairing the strength. The principal need in this respect is for the agent to reduce the surface tension in the mix.

*G. L. Lindsay (Universal Atlas Cement Co.)*—The amount of agent varies for different cements, and for the same brands from different mills. In six years of manufacturing air-entraining cement, very few difficulties have been experienced. The workability test is used to determine how much agent is required for 3 percent air. It is necessary to adjust mixes containing air-entraining agents because the air acts very much like fine sand, which suggests reducing the total sand and the water and adjusting the amount of cement accordingly.

*Harry F. Thomson (General Materials Co., St. Louis)*—The use of air-entraining agents is in curious contrast to the fact that transit mixers were being sold not so long ago on the claim that they would positively not entrain air. In central-mixed concrete, it has been found that one half ounce per cubic yard of a detergent increases workability, a characteristic that buyers like. Also a lower water-cement ratio is permissible, which makes up for the loss in strength from the air entrainment. The treated cements, on the other hand, produce a lower strength despite a lower water-cement ratio. Such cements are not general-purpose cements, and must be used cautiously by ready-mix plants selling structural concrete.

### Use in transit mixers

*Stanton Walker (National Ready-Mix Concrete Association)*—The evidence is inadequate and conflicting with respect to whether air-entraining cements should be used in transit mixers. Some tests have shown that agitation reduces strength by entraining air, but that there is no difference between 15 and 30 min. mixing time, and no difference between an inclosed and a pressure drum. A fundamental of the use of air-entraining agents is that a gallon of air in concrete does the same thing as does a gallon of another fluid, water.

*Prof. R. E. Davis (University of California)*—Tests indicate that most of the changes that occur in concrete made with air-entraining agents, such as decreases in expansion and strength, are proportional, in a rough way, to the drop in unit weight.

*J. H. Chubb (Pennsylvania-Dixie Cement Co.)*—It is not a good thing that specifications for portland cement permit only vinsol resin as an air-entraining agent, nor that the permissible proportions are so strictly set down from .0025 to .0045. It is difficult to get desired results without varying both the vinsol resin and the sand materially.

### Concrete tanks for gasoline

The great increase in military requirements for storage of fuel oil and gasoline coinciding with a storage of steel plate, resulted in the construction of many concrete tanks for this purpose. Moreover, because alkalis from the concrete destroy inhibitors placed in aviation gasoline to retard formation of gums that would ruin the gasoline, linings were required for tanks holding this type of product. Navy experience with these linings, which has been the most comprehensive, was described by Morris A. Spamer, of the Bureau of Yards and Docks, while Army experience was presented by E. R. Shepard, of the Office of the Chief of Engineers.

The Navy has approved and used the following type of lining materials—silicate of soda for fuel oil; Thiokol latex compounds and Amercoat (a syn-

(*Continued on page 89*)

## PRA to continue work on Inter-American Highway

Arrangements have been made to continue construction on the InterAmerican Highway in Honduras and northern Costa Rica with the assistance of the U. S. Public Roads Administration, according to Edwin W. James, chief of the Inter-American Regional Office of PRA. The construction work now being undertaken will help relieve unemployment caused in the two republics when the U. S. Army Engineers ceased road-building operations Oct. 31 last. Work was terminated because the U. S. Army General Staff felt the engineers were more urgently needed elsewhere.

"In northern Costa Rica," Mr. James stated, "the PRA has entered into a $2,-000,000 contract—the limit of its available funds—for additional construction of the Inter-American Highway in that region. Still further funds will be required to finish the job in northern Costa Rica.

"In Honduras the PRA has taken over on force account all the highway construction that still remains to be done on the route in that republic. In El Salvador, Nicaragua, and central Costa Rica the PRA is continuing construction that it had under way when the Army Engineers discontinued operations. Additional funds will be required to complete the work in southern Costa Rica."

The Guatemalan Highway Department is carrying on work the Army Engineers left unfinished in that country, the Army Engineers having turned over to the Guatamalan Government about $800,000 worth of road-building equipment on the condition that Guatemala spend a like amount on the Inter-American Highway.

"As for Panama," Mr. James said, "negotiations are being carried on with the Panamanian Government to finish 25 miles of road south of the Costa Rica-Panama border which the Army Engineers did not complete and to recondition 150 miles of highway farther south which the Panamanian Government built several years ago. The United States would contribute two-thirds and Panama one-third of the cost of construction."

In summarizing, Mr. James said a total of 560 mi. remains to be built on the 3,400-mi. route from Texas to the Panama Canal. Of this total, 410 miles is in southern Mexico. The remaining 150 miles are in northern and southern Costa Rica and in Panama. Further improvements are required on other sections of the highway which are open but not yet built up to specifications. However, it is now possible to drive in both the dry and the rainy season from Tapachula, Mexico, near the Guatemalan border, to the southern boundary of Nicaragua, and in the dry season motorists can drive on to Angostura, Costa Rica, which is 1,109 mi. from Tapachula and about a six-day trip by automobile from Tapachula.

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## Over $5,000,000 for road in British Columbia

Construction of the Pine Pass route, 274 miles of road between Prince George and Dawson Creek, B. C., will be gotten under way by the provincial government just as soon as weather permits and will be continued until the project is completed, Premier John Hart told the legislature, as he announced details of the $5,470,900 project. When the new route is finished Vancouver and Victoria will have a direct road connection with the Alaska military highway.

To put the route in shape, it will be necessary to reconstruct 165 miles of old road and construct 157 miles of new road. The width of the right-of-way will be between 66 and 80 feet, with a travelled way between 18 and 20 feet. Proper drainage will be provided, culverts installed and all bridges of a major character will be built on a permanent basis. The road will have a graveled surface 20 ft. wide. The premier stated $250,000 will be spent immediately on the location of this route, as well as for construction work to be carried out this year.

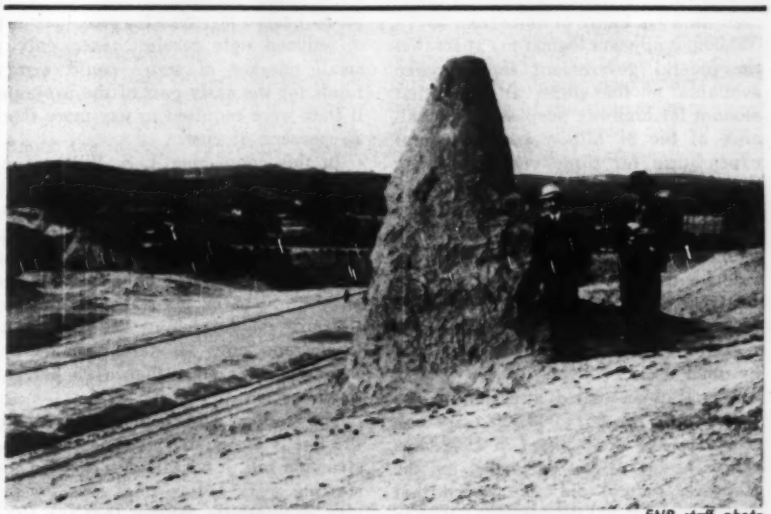
## Protest city wage scale for Texas rural roads

In a sharply worded legal brief filed with the federal Wage Adjustment Board, the Texas Highway Commission protests against a proposal from a Houston union to apply a San Antonio wage scale for construction equipment operators to similar operators in some fifty counties elsewhere in the state.

The brief by Atty. Gen. Grover Sellers, which followed a personal protest in Washington by State Highway Engineer DeWitt C. Greer, claimed the federal agency lacks authority to enforce any wage scale upon contractors working on Texas highway construction. Rates are set by state law. The brief says also that the action would violate state rights, is unjustifiable, and would directly affect the interest of state taxpayers by increasing labor one-third.

The effect upon municipal and county construction would be staggering, the brief added. If Texas' $84,000,000 a year postwar state highway program had to be based upon the Houston wage rate, the state contends, it would reduce by 2,520 miles the amount of road which could be built in three years.

The brief protests against this attempt to place upon agricultural counties the high wartime rates paid for federal construction in a metropolitan area. The State Highway Department said that it has never attempted to match high rates on federal projects and cannot do so.



ENR staff photo

## Brazilian contractors keep a check on engineers

*Brazilian contractors, like their North American colleagues, sometimes find the engineer's job estimates at variance with their own figures. To reduce arguments to a minimum so far as excavation is concerned, the contractors generally leave earth "cones" on the site until final payments for work done are approved. These cones of undisturbed earth, which show the original ground level, provide an exact and indisputable check on "before and after" conditions. The photo above was taken on a road job near Belo Horizonte where the cones could be seen at intervals along a side-slope cut.*

# Greater federal participation urged in highway work after the war

***American Association of State Highway Officials recommends to Congress that all federal automotive taxes be used for road work.***

Samuel C. Hadden, president, American Association of State Highway Officials, told the House Committee on Roads that the federal government is confronted with making a choice between retiring from the field of automotive taxation or returning to the states for road building purposes the entire proceeds from such taxes. He made this statement during testimony in support of H. R. 2426, the $3 billion postwar highway construction bill.

However, Mr. Hadden added that while it may ultimately be advisable for the government to retire from such taxing, "it is not the belief of the highway officials, that this is the best time to bring about such a change." To do so, he explained, would delay completion of the postwar highway financial program, "since it is very doubtful if the state legislatures would advance their state taxes fast enough to take up the slack." He added that 44 of the 48 state legislatures will not convene in regular session until next January.

### Large federal receipts

Mr. Hadden said that with postwar federal automotive taxes expected to exceed the 1942 figure of more than $677,000,000, it appears logical to expect that the federal government should make available to the states at least that amount for highway purposes. The balance of the $1 billion annual federal expenditure for three years following the war called for in H. R. 2426 can be justified by the federal government's obligations to foster interstate commerce, to construct post roads and provide for military highways, and by the fact that though the government is one of the largest highway users, it is not required to pay taxes such as are paid by other users.

Mr. Hadden called attention to the fact that of the $677,000,000 taxes collected by the government in 1942, less than one-fourth was returned to the states as federal aid. He added that despite the federal government's custom of diverting these funds to other than highway purposes it has penalized states for doing the same thing.

Though H. R. 2426 specifies that the half of the appropriation which would be expended on streets in urban areas and for secondary and feeder roads should be divided within each state in proportion to urban and rural population, an amendment is anticipated which would give flexibility to states to permit their spending the money in ways best calculated to meet their varying needs. The other half of the appropriation would go to federal aid highways in both city and country.

In regard to apportionment of federal money among the states, Mr. Hadden said that it is likely that amendment will be offered splitting the total appropriation arbitrarily, with one part apportioned among the states according to the old federal aid formula and the remainder apportioned in such a way as to recognize the peculiar problems of the states with large urban populations. This plan, he said, has much to commend it. Another suggestion which may be made, he said, is that the appropriation of an additional quarter billion dollars annually be authorized for apportionment in proportion to urban population. This, too, he believes, "merits careful consideration."

### Greater federal share favored

In advocating the 75 federal-25 state basis of sharing costs, as proposed in H. R. 2426—to replace the traditional 50–50 basis—Mr. Hadden said that due to reduced state gasoline taxes, only a small number of states could match funds for the early part of the program if they were required to pay more than 25 percent of cost.

In this connection J. S. Williamson, chief highway commissioner of South Carolina, told the committee that a questionnaire survey of the 48 state highway departments disclosed that only three states would be able to cooperate on a 50–50 basis. Six states anticipated difficulty in furnishing 25 percent of funds, and only 11 states indicated a preference for more than a 25 percent participation.

Mr. Hadden made it clear that though the bill is designated as a postwar construction bill, it contains a provision for starting work before total cessation of war, if Congress decides that the need for employment justifies an early start.

Numerous state highway commissioners and engineers are scheduled to testify during the hearings, which will probably last through March. Also expected to testify are representatives of the American Automobile Association, Associated General Contractors of America, American Road Builders, American Municipal Association, a number of cities and counties, and the railroads.

Testimony will end with that of Thomas H. MacDonald, Public Roads commissioner.

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## Construction work halted on third Panama locks

Main construction work on the third set of locks for the Panama canal, being tapered off since early summer, now has been halted and more than $30 million of the $106,758,800 appropriated has been impounded by the Bureau of the Budget. Total authorization amounts to $282,000,000.

If pending legislation to repeal appropriation of the $30,257,572—which will remain unobligated by the end of next June—is enacted by Congress, work cannot be resumed without a new appropriation. Provision for repeal is contained in H. R. 4183, the 1945 Army civil functions appropriation.

### Some work to go on

Despite cessation of work, however, Maj. Gen. Glen E. Edgerton, Governor of the Canal Zone, testified at hearings before the subcommittee of the House Committee on Appropriations, that some supplemental work will go on during 1944 and 1945. Funds are available for this work in the amount of $6,691,781 for 1944 and $2,767,473 for 1945, according to Gen. Edgerton.

The 1944 work will include completion of electrical, municipal and townsite work within camps for housing the design and construction forces, completion of relocation of railroad and power transmission in the Gatun area and highways in the Miraflores area, continuation of wet excavation in the lock approach channels, completion of installation of emergency power plants, and continuation of design and engineering work on the overall project.

The 1945 program includes completion of wet excavation for the lock approach channels, and continuation of design and engineering work.

For the latter purpose, the Governor is authorized to employ architects and engineers and other technical and professional men at a maximum rate of $50 per day for consultants.

The amount of impounded money, the Governor said, would "be applied to the resumption of construction work when it is directed by the secretary of war,—as soon as we can get strategic materials and shipping." The situation in regard to local labor is not as bad as formerly, he added. However, if the repeal legislation is passed money for new work will be available until re-appropriated.

## Concrete specialists review developments

(*Continued from page 86*)

...etic resin) for diesel oil; Thiokol ...tex compound, Thiokol FA sheets ...d Amercoat for high octane gasoline. ...hiokol FA sheets are the best but also ...e most expensive, partly because a ...ecial adhesive required in their ...plication gives off noxious fumes ...at must be carried away by an ...borate ventilation system. The sur...ce of the concrete must also be smooth ...d dry. Best conditions for application ...e found when absorptive form linings ...ve been used on the concrete.

The next most costly lining is the ...mercoat, which is low in tensile ...ength and thus does not bridge ...cks efficiently, but otherwise is quite ...tisfactory. It is brushed on in a prime ...at, two enamel coats and two seal ...ats, and is so easily applied that it ...s been used on all tanks in remote ...cations; most diesel oil tanks also are ...ed with Amercoat.

The Thiokol latex compound is the ...eapest, but it, too, has a low tensile ...ength. It is brushed on, and recently ...s been combined with an osnaburg ...bric to reduce the cracking tenden...es. Two primary coats are followed by ...e fabric, then two more primary coats ...d finally two protective coats. About ... million sq. ft. of each type of lining ...ve been used by the Navy.

#### Army uses small tanks

In contrast to the enormous gasoline ...nkage of the Navy, that of the Army ...small. At least, that reported by Mr. ...epard involved only 36 tanks of dif...rent kinds, none larger than 50,000 ...l. One interesting tank is a double ...ll design with a water seal and no ...otective lining, which has proved ...tisfactory for gasoline because the ...ter is changed frequently and thus ...es not acquire a high alkali content ...damage the gasoline. The Army has ...nd fabric-reinforced Thiokol latex ...ings satisfactory if ground moisture ... not present. Oil foil, a magnesium ...ychlorite cement, has proved to be a ...tisfactory lining in the presence of ...oundwater.

Related to these two papers, although ...esented at another session, was a re...rt of J. C. Pearson (Lehigh Portland ...ment Co.) on some tests of coatings ... gasoline-resistant concrete tanks. ...e report was principally devoted to a ...cription of test apparatus and pro...dure, the former being a precast con...te pot of about three liters capacity, ...aled on top with a glass plate. The in...e of the pots were painted with the ...ing to be tested, filled with gasoline, and then periodically weighed to determine loss of gasoline through the concrete walls.

#### Action on specification

Several important developments in ACI specifications resulted from the meeting, all centering on the work of the small contractor and the non-scientific field man. Among specifications adopted as standard were those relating to the design of concrete mixes, to concrete pavements and bases, to cast stone, to precast floor units, and to the construction of concrete silos.

Principal discussion centered on the recommended practice for concrete mix design as presented by a committee under the chairmanship of R. F. Blanks (Bureau of Reclamation). As explained by Mr. Blanks, the specification was developed for jobs lacking laboratory control; it therefore contains tables and charts of average values that are safe even though probably inexact for a given job. The specification sets up the fundamentals of concrete making on an absolute volume basis, so that small-job field men can in the future understand the more scientific language of the laboratory.

#### Mix specifications opposed

Chief dissenter on the specification was A. T. Goldbeck (National Crushed Stone Association), who thought the use of average strength values was wrong since it permits no advantage to be taken of good aggregates, whose use would allow a lower cement factor. Mr. Goldbeck thought the whole recommended procedure of mix design to be unnecessarily complicated; a much simpler procedure would be to specify the amount the coarse aggregate, which would automatically fix the right percentage of sand. A. C. Avril, of Cincinnati, also objected to the requirement that test results be obtained from samples from the job mixer. Such samples may not be representative of the mix, he said, and it is better to make trial batches by hand for testing purposes.

H. F. Clemmer, Washington, D. C., chairman of the committee that prepared the pavement concrete specification, pointed out that this was prepared for small cities and counties and for those jobs where roads are merely a part of the total project. Therefore it merely sets limits as guide posts rather than being an exact specification. As a consequence, it must be kept up-to-date, and the committee is to be kept active for that purpose.

As is usual, much interest was evidenced in the concrete products session. This year the specification committee reports, while important, were routine, the greatest attention was focused on a paper by C. F. Moore (Portland Cement Association) on "War-Born Concrete Products".

Only a few of the many special uses of concrete described by Mr. Moore can be cited, but his paper emphasized the huge quantities of concrete materials that went into small projects, as compared to huge projects, such as factory roofs, hangars, etc. For example, nearly 700,000 precast concrete shower stalls went into war housing; one airport required 18,000 concrete catch basins; and over a million ballast blocks for ships were sold in a year in the New York area.

Mr. Moore told of the extensive use by farmers of concrete burial vaults for water tanks and milk coolers, and of the successful development of concrete bathtubs whose surface finish resembles polished stone. Cast stone manufacturers, used to making 2,000 lb. per sq. in. concrete, learned how to turn out products having 10,000 lb. unit strength. All these developments supported Mr. Moore's conclusion that experience with war-born concrete products has provided a firm base for postwar developments of wide utility.

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## Ban on non-residents for state-financed work

Ninety-five percent of the employees of a contractor on a public works job for the State of Washington or any political subdivision within the state, excepting projects financed in whole or in part by federal funds, must now be bona fide residents of the state if more than 50 persons are employed, and 90 percent must be in that classification if 50 or less workers are put on the job.

These and other provisions of a new law passed by the 1943 state legislature must be written into every public contract.

A resident of the state is defined in the act as any person who has been a bona fide resident for a period of 90 days prior to employment on the project.

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## Canada further relaxes some building controls

Further relaxation of Canada's wartime controls over construction were announced in Ottawa on Feb. 24 by Munitions Minister C. D. Howe. The construction, repair, or alteration of plants previously exempted from license up to a value of $2,500 are now exempt up to $5,000. For other than plants, the limit has been raised to $1,500.

# JOBS OF THE WEEK

***HOUSING, San Lorenzo, Calif.***

The Greenwood Corp., San Francisco, Calif., awarded a contract for 1,329 housing units, storm and sanitary sewers, sidewalk, curbs and street work to Bohannon & Chamberlain, San Mateo. The estimated cost will be $6,844,350.

***IRRIGATION PROJECT, Mexico***

S. J. Groves & Sons Co., Minneapolis, Minn., was awarded a contract by Azucar Irrigation District, Reynosa, for an irrigation project, canals, operating facilities, locks, etc. The estimated cost is $4,000,000.

***HOUSING PROJECT, Tampa, Fla.***

Public Housing Authority, Atlanta, Ga., awarded a contract for a housing project on Lake Avenue, to Paul Smith Construction Co., Tampa, Fla., at $1,569,846. M. Leo Elliott, Tampa, is the architect.

***PLANT, East Chicago, Ind.***

Krahl Construction Co., Chicago, Ill., has been awarded a contract by the E. I. duPont de Nemours & Co., Inc., Wilmington, Del., for a plant. The estimated cost is $2,000,000.

***OIL REFINERY, Saudi, Arabia***

Arabian-American Oil Co., Saudi Arabia, care of Standard Oil Co. of California, San Francisco, Calif., awarded a contract for constructing and equipping an oil refinery to Bechtel-Price-Callahan, Minneapolis, Minn.

***HOUSING, Warner Robins, Ga.***

Public Housing Authority, Atlanta, Ga., received lowest bid for housing from M. B. Kahn Construction Co., Columbia, S. C., on alternate X-4 at $1,355,400; also alternate X-2 from Birmingham Building Co., Birmingham, Ala., $1,174,791. Dennis & Dennis, Atlanta, Ga., are the architects.

***HOUSING, Long Beach, Calif.***

Public Housing Authority, Los Angeles, Calif., has awarded a contract for 1,000 temporary dwelling units near Sante Fe Ave. and Willow St. to J. K. Thomas and Beyer Construction Co., Los Angeles, Calif., at $1,883,739. Flewelling, Wing & Lyndon, Los Angeles, are the architects.

***HORSESHOE DAM, Phoenix, Ariz.***

Mittry Brothers Construction Co., Los Angeles, Calif., were lowest bidders for constructing Horseshoe Dam on Verde River, when Phelps Dodge Copper Corp., Douglas, opened bids. Schedule A was bid at $1,365,750; alternate B $1,680,400. Leeds, Hill, Barnard & Jewett, Los Angeles, Calif., are the engineers.

***PLANT, Philadelphia, Pa.***

Publicker Commercial Alcohol Co., Philadelphia, Pa., awarded contract to design and construct plant reclaim cattle feed from grain used in alcohol production to United Engineers & Constructors, Inc., Philadelphia, Pa. The estimated cost is $3,000,000. Defense Plant Corp., Washington, D. C., will finance.

***PLANT, Philadelphia, Pa.***

United Engineers & Constructors, Inc., Philadelphia, Pa., has been awarded a contract to design and construct reclaiming plant by Continental Distilling Corp., to cost $1,900,000. Defense Plant Corp., Washington, D. C., will finance.

***APARTMENT BUILDING, Cleveland, O.***

Charles Schulz, Cleveland, O., awarded a contract for masonry for eleven 2 story, basement, apartment buildings by Shaker Square Apartments, Inc., Cleveland. The estimated cost is $1,500,000. G. H. Burrows, Cleveland, is the architect.

***AVIATION FACILITIES, Chincoteague, Va.***

Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded a contract for additional aviation facilities at Naval Air Station, to Virginia Engineering Co., Newport News, Va., at $1,764,200.

***MARGINAL PIER, etc. Port Chicago, Calif.***

Bureau of Yards & Docks awarded a contract for constructing marginal pier and services, to Macco Case Construction Co., San Pedro, Calif., at $1,077,700.

**Note—Additional bidding and contract news on many projects large and small appear in the Construction News section beginning on page 92.**

## Contractor loses suit for Hetch Hetchy pay

After more than five years of litigation, involving an appeal to the U. S. Supreme Court, Transbay Construction Co. lost a suit for $1,000,000 against the City of San Francisco in connection with the raising of O'Shaughnessy Dam of the Hetch Hetchy water and power project. (Unit prices *EVR*, April 13, 1935, p. 540; construction description *ENR*, May 25, 1939, p. 707). The project was completed in 1938 at a cost of about $3,500,000. Cause of action was the contention of the contractors that while their original contract called for the excavation of 30,000 cu.yd. of rock in providing anchorages for the dam they actually excavated 84,000 cu.yd. before all authorities were satisfied that seams and fissures had been cut away and all menace from overhanging rocks removed.

In a suit filed against the city in November, 1938, the Transbay Co. sought $850,000 for the extra work performed, plus interests and costs which formed a combined total of about $1,000,000. The first trial, heard in the Federal District Court in San Francisco, resulted in a decision in favor of the contractors and a master subsequently fixed $791,000 as the amount the city should pay.

An appeal taken by the city resulted in a reversal of the lower court's findings. Counsel for the Transbay Co. sought to have the case heard in the U. S. Supreme Court, but that body refused to assume jurisdiction. Transbay then sought to file an amended complaint in Federal court, but a petition to that effect was denied March 1, thus closing the case.

In resisting the suit, the city argued that the Transbay Co. should have refused to comply, without rescinding the original contract, when the city requested the additional work.

• • •

## Engineer officers named for promotion in rank

On March 3 President Roosevelt nominated a number of Engineer Officers for promotion in rank, as follows:

To lieutenant general: Major General John C. H. Lee, commanding the Army Service Forces in the European theater of operations; and Major General Raymond A. Wheeler, now in the China-Burma-Indian theater.

To brigadier general: Col. Royal B. Lord of Worcester, Mass., former public relations director of the War Department, who is chief of staff to General Lee in London.

## OBITUARY

**Ralph Norman Begien,** 69, at one e general manager of the Baltimore Ohio Railway, died Feb. 27 at Richnd, Va. His first railway experience s as assistant engineer in charge of dges and location for the Guayaquil Quito Railway, in Equador. Re-ning to this country in 1900, he was a time a mathematician for the Office the Surveyor, in Washington. In 02, he entered the employ of the ltimore and Ohio Railway, rising to ition of general manager. In 1923 went to Richmond as vice-president charge of operations for the Chesake & Ohio Railway, and retired from company about seven years ago.

**Martin J. Lyons,** Sr., 68, former presit of the Lyons, Flattery Construction p., and assistant chief engineer in office of the Bronx Borough Presit, New York City, fifteen years ago, Feb. 25. Mr. Lyons helped super- the construction of the subway tun- under the Grand Concourse, Ford- Plaza, and the Dyckman Street dge of the New York Central R. R.

**Charles A. Thanheiser,** 62, prominent tractor of Houston, Tex., died there . 8. Mr. Thanheiser was organizer president of the Southwestern Conuction Co. at Houston. He sold out 1931.

. S. Carpenter, 69, retired bridge tractor of Des Moines, Ia., died there ently. His firm, the Federal Bridge , operated in Iowa and other midtern states until six years ago.

**. B. Blanchard,** prominent Nova Scotia engineer and for many years resident engineer of the department of highways, died Feb. 23.

**Thomas A. Raymond,** 56, a former state highway engineer and former city engineer of Frankfort, Ky., died there Feb. 9.

**Irving W. Wortman,** 59, one of the pioneers in the crushed stone industry in New Jersey, died at Morristown, on Feb. 27.

**David L. Underwood,** 75, former Marion County, Ohio, county surveyor, died Feb. 14.

News of the Week
Continued on p. 130

# CONTRACTS AND CAPITAL

CIVIL ENGINEERING construction volume in continental U. S. totals $44,579,000 for the week. This volume, not including the construction by military engineers abroad, American contracts outside the country, and shipbuilding, is 13 percent higher than in the preceding week, but declines 51 percent from the total for the corresponding 1943 week.

Private construction is 10 percent above last week, and 220 percent above last year as a result of the increased volume of large-scale private residential building. Public construction is up 14 percent compared with a week ago, but is 65 percent below a year ago.

The current week's construction brings 1944 volume to $358,386,000 for the ten-week period, a decrease of 49 percent from the $709,277,000 for the 1943 period. Private work, $80,550,000, is 30 percent higher than last year, but public construction, $277,836,000, is 57 percent lower due to the 60 percent decline in federal volume.

In the classified construction groups, gains over last week are in waterworks, sewerage, commercial building and large-scale private housing, and public buildings. Increases over the 1943 week are in waterworks, industrial and commercial buildings, and earthwork and drainage.

New capital for construction purposes for the week totals $13,908,000. It is made up of $9,908,000 in state and municipal bond sales, and $4,000,000 in corporate security issues. The week's new financing brings 1944 volume to $173,861,000, a total 196 percent above the $58,759,000 reported for 1943.

### CONTRACTS
**Continental U. S. Only**
**(Thousand of Dollars)**

| | Week Ending Mar. 11 1943 | Mar. 2 1944 | Mar. 9 1944 |
|---|---|---|---|
| Federal | $83,828 | $17,276 | $28,652 |
| State & Municipal | 2,089 | 9,151 | 1,592 |
| Total Public | $85,917 | $26,427 | $30,244 |
| Total private | 4,483 | 12,984 | 14,335 |
| TOTAL | $90,400 | $39,411 | $44,579 |
| Cumulative 1944 (10 weeks) | | | $358,386 |
| 1943 (10 weeks) | | | $709,277 |

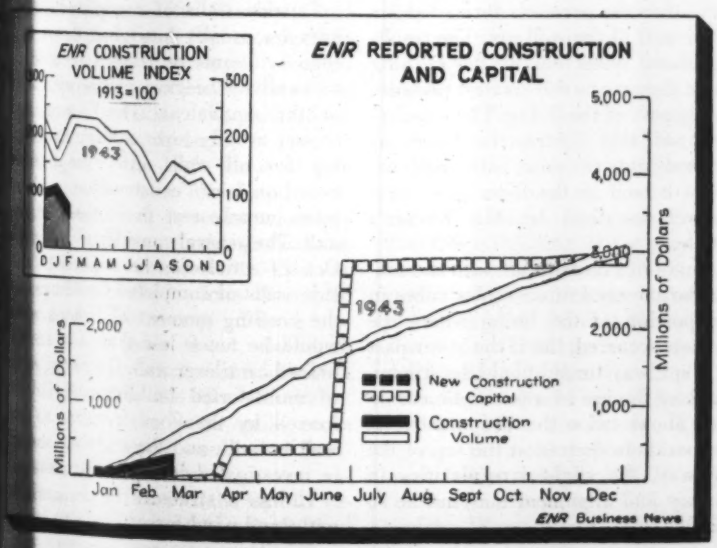
Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

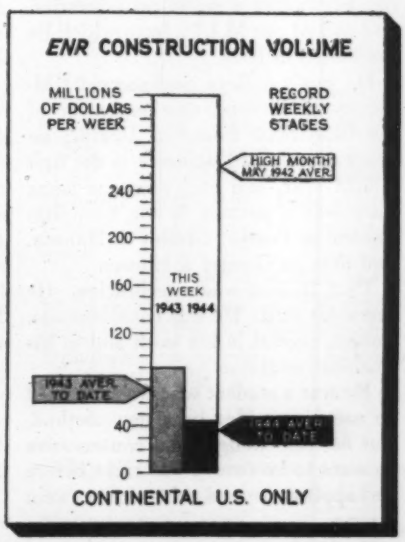
### NEW PRODUCTIVE CAPITAL

| | 1943 10 weeks | Cumulative 1944 10 weeks |
|---|---|---|
| NON-FEDERAL | $58,759 | $83,029 |
| Corp. Securities | .... | 51,176 |
| State & Mun. | 54,171 | 26,278 |
| RFC Loans | 1,500 | 5,575 |
| FPHA Loans | 3,088 | .... |
| FEDERAL | .... | $90,832 |
| TOTAL CAPITAL | $58,759 | $173,861 |

### ENR INDEX NUMBERS

| Index base=100 | | 1913 | 1926 |
|---|---|---|---|
| Construction Cost | Mar. '44 | 295.34 | 141.97 |
| Building Cost | Mar. '44 | 232.32 | 125.59 |
| Volume | Feb. '44 | 86. | 38. |


ENR CONSTRUCTION VOLUME INDEX 1913=100
1943
D J F M A M J J A S O N D
ENR REPORTED CONSTRUCTION AND CAPITAL
1943
New Construction Capital
Construction Volume
Millions of Dollars
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec
ENR Business News



# Comment and Discussion

**Readers' opinions on matters that concern engineers and contractors**

## Paul Hansen—A Tribute

Sir: Another of America's top flight sanitary engineers is gone. Paul Hansen had gradually come up to the top rung of the ladder during the last two decades, until in recent years he was recognized as such by New York, Philadelphia, Toledo and Washington, to mention only a few of the large cities of the country that have called upon him for advice in solving sewage and water supply problems.

Paul was seldom at home and when he was he didn't relax very often. He did a great deal of traveling, with a different problem to greet him at every journey's end. He had fun, I know he did, for I've had fun with him.

Of course his firm has been very active during the war, supervising the design and construction of camps and of sanitary provisions for many munition manufacturing plants. In the first war he helped to get water to the troops at the front in France, and in this war his labors were on this side of the Atlantic, still dealing with water.

He was of Danish descent, born in Washington, D. C., where his father owned the fine old silversmith store of Schmidtie Bros. His parents would have been delighted if their only child had stayed to carry on the business but he wanted a technical education and picked out M.I.T., from which he graduated in 1903.

He was a college professor at University of Illinois; chief engineer of the Ohio State Board of Health; an army captain of Engineers in the first World War, and ever since he came back was a partner in the firm first known as Pearse, Greeley & Hansen, and then as Greeley & Hansen.

Paul Hansen was a technician. He knew his stuff. He was conscientious, honest, careful in his work and in his business relations.

He was a student who wasn't afraid to use a new idea or a new method, but he was enough of a conservative to want to be sure it was right before he applied it and he seldom went wrong.

Paul was gregarious—he liked men; he enjoyed going to meetings and conventions and knew an extraordinary large number of those attending the meetings.

I have known him for 45 years; we went to high school and college together, were fraternity brothers and he was best man at my wedding. We have been together often since leaving college and it has been a joy to see him grow to the point where he was accomplishing great things. He should have been allowed to go on.

Feb. 15, 1944

FARLEY GANNETT
*Gannett, Eastman & Fleming Inc.*
*Harrisburg, Pa.*

## A Challenge to Designers

Sir: Your editorial in *ENR*, Nov. 18, 1943, p. 737, covering the article by K. B. Keener on the invert break in the Boulder Dam spillway tunnel caused by erosion (p. 762) gives some food for thought. It is, as you say, a challenge to hydraulic designers.

There is another point, however, which might have been mentioned in connection with the model studies of the spillway design. Looking at Fig. 2 (p. 763), it will be seen that the 225-A radius shown in the lower part of the spillway design is a much sharper curve than the parabola formed at the upper part of the spillway. The resulting sharp deflection of the rushing water thus exerts the greatest pressure at this part of the lining. The development of this destructive force, as pointed out in your editorial, expressed itself in the form of erosion so well-described by Mr. Keener's article.

I may not be familiar with the reason for the need of a circular curve in the portion of the lining where the erosion occurred, but if the lower part of a spillway tunnel could be streamlined by the use of a parabolic curvature about twice the proportions of the parabola desired at the top of the spillway, the slight irregularities in surface and alignment may not be so critical.

Fundamentally, the form of the s
sign may be the important factor
the case. As intimated in the artic
the surface irregularities are, in
sense, an incidental defect in the ba
design form. Further hydraulic
search with model studies in whi
the above-suggested reverse tran
tions in balanced proportions are
corporated should shed some li
on the primary cause of the difficul

WILBUR H. SIMONS
*Public Roads Administrati*
*Washington, D.*

## Wind Pressure on Walls

Sir: The letter by Jacob Feld, *EN*
Nov. 18, p. 734, might be misinte
preted to refer to masonry walls
general whereas my article in *EN*
Oct. 21, p. 630 referred to a cantilev
wall during construction of the buil
ing and without lateral support
the top of the wall.

The failure of the fire wall describe
in that article could have be
avoided by not building the fire wa
so high until the windows in the o
side south wall of the building h
been installed. If windows had not a
rived, temporary boarding could ha
been applied in the window openin
if it seemed desirable to keep t
masons occupied. No question was i
tended to be raised regarding the st
bility of the wall after it had be
braced at the top by anchored hea
timber purlins, wall beams and r
trusses and after the window openin
had been closed in. The top of t
wall which failed completely w
about two weeks old and the wor
manship was excellent.

Outside walls of completed buil
ings are usually braced at floors a
roof by beams or trusses secured
the wall by bearing plates with l
or the equivalent. The beams a
trusses usually form continuous ho
ing for all walls. An exception
board-on-joist construction, wh
joists merely rest in recesses in
wall. The general considerations in
Oct. 21 article can be applied to o
side walls of completed buildings
the bending moment of braced wa
would be much less than for an
braced cantilever wall. However, wa
of multistoried buildings should
braced by the floor framing as
wall is built, and the stability sho
be investigated during construction.

Unless a structure is designed
withstand wind forces likely to oc

en its safety is dependent upon the nd not blowing very strongly. rring being struck by the vortex of major tornado, it is common good actice to design structures to resist ecific wind loads rather than to rely on strong straightaway winds not owing in a critical direction.

The "free standing walls 10 ft. or re in height made of 12-in., and in me cases 8-in. hollow masonry its" mentioned by Mr. Feld could hstand severe windstorms because the wind striking the wall at an in- ned direction or because partially eltered by high buildings to the ndward. An actual failure of an 8- concrete block interior fire wall ft. high and 160 ft. long occurred July, 1942. It was blown over by a lden straightaway squall about a nth after completion of the wall before the roof had been installed. ere was a long delay in obtaining f lumber. Cement-lime mortar was d and joints were well filled. There re 16x16-in. piers about every 20 which were not filled and contained vertical reinforcement. Nearby eather Bureau data were not avail- le. Such an accident could be oided by delaying the construction the interior fire wall until the roof tallation was progressing and win- ws in outer walls had been pro- ed.

Two cinder block cantilever walls, in. thick, 27 ft. high and 115 ft. 16 ft. long blew over in July, 43, during a local straightaway ual. The Weather Bureau station s too distant to give a good report the wind velocity. The walls had n completed over four months. The 5-ft. wall had nine equally spaced in. pilasters and the 16-ft. wall two asters. In falling, the walls dam- d valuable equipment.

Regarding the 12-ft. fence of con- te blocks which Mr. Feld reluct- ly reinforced, it seems necessary investigate the strength on the basis a modulus of rupture of 24 psi., as ermined by the National Bureau of ndards as an average of three con- te block walls tested, the dead ght, and a critical wind load, about explained in the Oct. 21 article. in falling, the fence could cause ury to persons, it would seem justi- le to protect the public.

Regarding Fig. 2 in the Oct. 21 ar- e, the curves for true velocity and Robinson cup anemometers were obtained from data on p. 737-738 of the National Bureau of Standards Research Paper No. 301 (obtainable from the Superintendent of Documents, Washington, D. C., for 10c.). An increase of 50 percent for gusts up to 40 m.p.h. is given on p. 655 of the Bureau of Standards Research Paper 221. Later tests by the U. S. Weather Bureau that confirm these earlier tests are given on p. 301 of the Oct., 1941, Edition of "Monthly Weather Bureau Review." The increase for gusts is understood to be appreciably reduced for very high 5-min. averages. It is hoped that data will be obtained by the Weather Bureau at some of the stations having two types of instruments, but until then the increase for gusts at high velocities is a matter of opinion.

Mr. Feld's reference to wind velocity variations with height above surrounding ground does not seem particularly important, so far as designing walls for varying heights of walls is concerned, because we are dealing with actual failures of relatively low walls. True, Weather Bureau anemometers are not located at grade and recorded velocities do vary with elevation and partial shielding by nearby buildings. More data admittedly are needed regarding the relationship between velocities recorded at Weather Bureau stations and the elevation of these stations above grade. The following information is submitted but with regrets for its meagerness.

The Weather Bureau anemometer at the East Boston Airport is 62 ft. above grade, in an exposed location. The velocities recorded there were, for the same winds, about the same or slightly higher than recorded on top of the old Post Office Building, which anemometer was 154 ft. above grade and about 1⅛ miles distant. Surrounding city buildings are about 100 ft. high. The anemometer on the new Post Office Building, at the same location in the city proper, is 360 ft. above grade and velocities read about 25 percent higher than at the airport. The airport readings are those officially assigned to Boston.

During the New England hurricane of Sept., 1938, the Boston Weather Bureau (airport) reported a maximum 5-min. average of 73 m.p.h. (Robinson anemometer). A gust recording Dines anemometer (Yankee Network) about two miles distant and about 50 ft. higher recorded gusts of 80 m.p.h. during the interval of the 5-min. maximum, although about an hour later there was a gust of 99 m.p.h.

At about the time of partial collapse of a large sign in Chicago November, 1940, the U. S. Weather Bureau, 6½ miles to the windward, recorded a maximum 5-min. average velocity of 42 m.p.h. (Robinson anemometer). There was a Dines anemometer, which records the instantaneous velocity of gusts, at the same location and during the same 5 min. recorded a maximum gust velocity of 65 m.p.h. This value checks well with Fig. 2 in the Oct. 21 article.

The last paragraph in Mr. Feld's article seems to draw some questionable conclusions. "One story separating walls, similar conditions, and one story factory buildings" would not necessarily need strengthening after completion and when well braced by the roof. Before completion of a wall, care should be taken to prevent windstorm damage, and an estimate of strength should be made. As a general rule, a 5-min. average wind velocity of about 67 m.p.h. is recommended, although for coastal territories subject to violent hurricanes or on high hills or mountains a more conservative factor of safety could well be used in the design, giving due consideration to public safety. High cantilever walls without bracing should be adequately designed for probable wind loads rather than relying upon beneficent winds.

H. A. SWEET, *Engineer,*
*Associated Factory Mutual Fire Ins. Co.,*
*Boston, Mass.*

## A Correction

January 10, 1944

Sir: With reference to my article "Live Load Reactions to Timber Stringers" in the Dec. 2 issue of ENR, I have the following correction to make:

Equations 3 and 4, p. 812, should be the same, that is, $P_m$ and $P_s$ are the same except for the constant terms. Equation 3 is correct. Equation 4 should be as follows:

$$P_s = W\,\frac{1024I_sS^3 + 45L^3d^3}{1024I_sS^3 + 135L^3d^3}$$

Would it be possible to publish a correction in an early issue of *Engineering News-Record.*

J. E. LOTHERS.

# EDITORIALS

VOLUME 132 NUMBER 10

March 9, 1944

## Building Code Modernization

ONE OF THE MOST FREQUENT statements heard in postwar conversations is that "Building codes should be modernized". It has a resonant and imperative ring, but too often is as devoid of reason and thoughtfulness as that other cliche, "There ought to be a law". For example, the decade before the war abounded with code revision activities. That fact is often forgotten when we now talk of instituting code modernization in preparation for a postwar building boom. Some of this work resulted in building codes that are as good as expert ability can make them, while other "modernized" codes are worse than their predecessors. The shortcoming of that early activity was that too often it was opportunistic, superficial and lacking in the application of basic concepts of building code provisions. This critical and perhaps carping discussion of things as they are is set down to emphasize the importance of a little 15-page booklet, "Building Codes—An Essential Tool in Urban Development", prepared by the construction and development department of the Chamber of Commerce of the United States. Consisting of a foreword on the need for building code improvement by E. P. Palmer, chairman of the department, and an analysis of what a code is supposed to be by George N. Thompson of the National Bureau of Standards, it should be read by every official concerned with building code preparation or administration. Copies are available from the Chamber of Commerce office in Washington, D. C.

## Who Would Have Thought It?

THE KALEIDOSCOPIC DEMANDS of modern war were never better illustrated than by the present situation with respect to lumber. No more is heard the plea, "Build it of timber and save steel." It is timber that now is scarce, and it is timber that the war needs most. From the bottom of the critical list, timber has jumped to the top. Designers not only can go back to steel if they like, they must use steel if at all possible. They are even restricted in their use of concrete because it requires unavailable lumber. Behind this lumber shortage is an almost inconceivable rise in demand for crates and boxes, coupled with a drop in lumber production brought about by manpower shortages in the forests. The 15 billion feet of crating lumber required this year will approach fifty percent of the total cut. Nor will the end of war in Europe reduce this demand appreciably, for amphibious warfare, such as is required in the Pacific theater, gobbles up lumber at a prodigious rate. Crates that have to be floated to the beach and pushed around with bulldozers have to be substantial. Moreover, they require large amounts of special paper for waterproofing, and this is made from pulpwood, which must also come from the undermanned forest operations. These lumber shortages do not present a rosy picture for an early start on postwar construction. The prospects for such work can only be improved by broad appreciation of the fact that timber is now the No. 1 critical material, coupled with the same effort to conserve it as was applied to copper, steel and aluminum earlier in the war. Here is a new war task for the construction industry.

## Paul Hansen

WITH THE DEATH of Paul Hansen on Feb. 6, the field of sanitary engineering lost one of its great practitioners. His name was associated with many of the important sewage disposal and water supply projects of this country and he took a leading part in the work of numerous boards whose recommendations formed the basis of sanitary improvements that have affected the welfare of millions of people. But it was not engineering ability alone that made Paul Hansen stand out from among his fellows. That ability was complimented by a deep and sincere interest in those with whom he was associated, especially the younger men. Friendly, courteous and modest, his counsel was eagerly sought and generously given. Especially notable among his many services to his chosen profession was his active participation in the difficult work of getting public recognition of the need for adequate compensation for consulting engineering services, work that lead to the now quite general acceptance of standardized fees for such services. And it was in that work that the unselfishness of his interests was most evident. Not only did he seek adequate compensation for the principals—he likewise insisted that the standards be set high enough so that the consulting engineer could adequately compensate his employees in the "back office." If the engineering profession would honor Paul Hansen it could find no more fitting memorial than a simple

edge that the workers in the back office will not forgotten.

## rovincialism at Its Worst

E STATE OF Washington recently passed a law quiring that 95 percent of the employees on blic works contracts of the state or any of its bdivisions be residents of the state. This is an tion that will stifle competition and will result in gher costs to the taxpayer. An outside contractor o is prevented from bringing in the men whose ilities he knows and whom he can trust with a chine or a portion of the project must bid high cause much of the managerial talent that he norlly would devote to the job must be given to ining a new crew. But if higher costs do not ncern the legislators of Washington, they should ink twice before shutting their doors to citizens m other parts of the country who provide the deral funds spent so liberally in that state during e past decade.

## ndorsed by the Architect's Institute?

LINOIS ARCHITECTS have been revealed as the al instigators of the court action that resulted in e Illinois Professional Engineering Act being clared unconstitutional. Funds to carry the fight ainst that act to the state supreme court are ked for in a letter to the architects throughout linois signed by the presidents of the Illinois ciety of Architects and the Chicago Chapter of e American Institute of Architects.

One sentence in this circular letter to Illinois chitects may give a clue to the reason back of this fort to keep Illinois engineers from obtaining a gistration law. This sentence reads: "We are d that if the law as written prevailed, all engiers, electrical, mechanical, etc., could engage in rtain building operations under the law, but that censed architects would be obliged to employ enneers of various descriptions." The Illinois engier's license law contains an exemption for "the actice of any other recognized profession."

Architecture is one of those professions, hence ere can be no justification for a belief that the w engineer's license law would be used to attack e legitimate practice of registered architects. Can be then that the architects back of this movement are doing mechanical and electrical engineering work without the technical qualifications for such work and fear that their work is of such inferior character as to involve them in charges of malpractice if Illinois had an engineers' license law on its statute books?

As the Chicago Chapter of the American Institute of Architects now is on record as a party to this attack on the engineers' license law in Illinois, the institute itself can no longer escape responsibility for it. The institute must either condone the Chicago Chapter's action by its continued silence or it must openly condemn such unprofessional action.

## One Place for Retrenchment

DESPITE THE FACT that the Army engineers abandoned work on the Inter-American Highway in October because it was considered to be of no further military importance, arrangements have been made with the U. S. Public Road Administration to continue that work in Honduras and Costa Rica "to relieve unemployment", and negotiations are underway for similar work by the PRA in the Republic of Panama. At least two thirds of the cost is to be borne by the United States government under the Inter-American Highway Act of 1941. The PRA also is continuing the work it had under way in El Salvador and Nicaragua.

There seems to be good reason to ask why new work is being inaugurated on the Inter-American Highway at this time when this country is supposed to be bending all its efforts and its financial resources to winning the war. Certainly there is reason to question the undertaking of additional highway work in Costa Rica, where citizens have publicly criticized the Army Engineers because of the little progress they were able to make under the severe conditions encountered. The $2,500,000 of new work in Costa Rica for which the PRA has entered into new contracts may appear small in these days, but it still is *two and one half million dollars* that will have to come out of the taxpayers of this country.

The Inter-American Highway is of no military value. Work on it should not be continued just to relieve unemployment outside of our own borders. Congress, in looking for places to retrench without injury to the war effort, should put that highway at the head of its list.

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ENGINEERING ABROAD — AS SEEN BY ENR EDITORS

# An Engineer's Role on a Rubber Plantation

**Edward J. Cleary**
Managing Editor, Engineering News-Record

***Contents in Brief**—One of the most notable examples of private enterprise at work in foreign fields is to be seen in Brazil where the Ford Company has been developing a rubber plantation. This project in the Amazon basin holds special interest for the engineer, whose skills have provided the physical facilities around which this development has been made possible.*

FROM THE VIEWPOINT of the engineer the accomplishments on the Ford Rubber Plantation in Brazil commands the greatest interest and admiration. Picture yourself with the assignment to plan and execute the development of a two-million-acre tract in the jungle. How do you start a a job of this kind from scratch? Where do you locate villages, what kind of a road system will be needed, how about water supply and what is the overall estimate of facilities—such as housing, shops, communications, equipment and the thousand and one other things—to establish a self-contained enterprise 500 miles up the Amazon basin?

Every harassed municipal engineer or construction superintendent who thinks he has problems might ponder his situation, and then compare it with the challenge that faced a hardy band of technicians who camped on the banks of the Rio Tapajoz one night in December, 1928.

True, these men were backed by great resources. But they were also aware of the failures that had resulted from previous efforts to grow rubber on a plantation scale in tropical America. For example, the agricultural technicians knew that the success of such an enterprise in the western hemisphere depended, among other things, on the possibility of developing a strain of tree resistant to a fungus parasite, commonly called South American leaf disease.

Equally concerned were the engineers who swung in their hammocks that hot and humid December night, walled in by the heavy jungle growth. It was their task to plan and build the physical facilities around which the project might exist and expand. In a sense they were pioneers, for there was little precedent for an undertaking of this scope and calibre.

What has been accomplished by the Ford Company in the Amazon through the application of engineering and agricultural skill ranks as one of the outstanding examples of North American private enterprise at work in foreign fields.

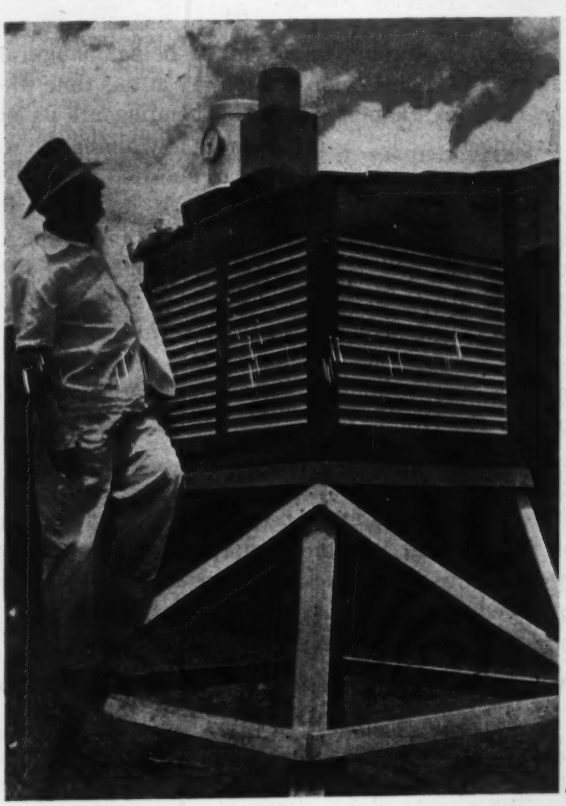


***Fig. 1. Archie Weeks, engineer and construction superintendent on the Ford Rubber Plantation in Brazil since the start of operations in 1928, checks the operation of an automatic rain gauge.***

*ENR staff photos*

### A bit of background

Why so little has appeared in print about this project (and there is virtually nothing available on the engineering aspects) may be due in part to the remoteness of the plantation. There is also the possibility—which was implied during my visit—that there has been reason to resent the writings of certain travellers whose superficial ob-

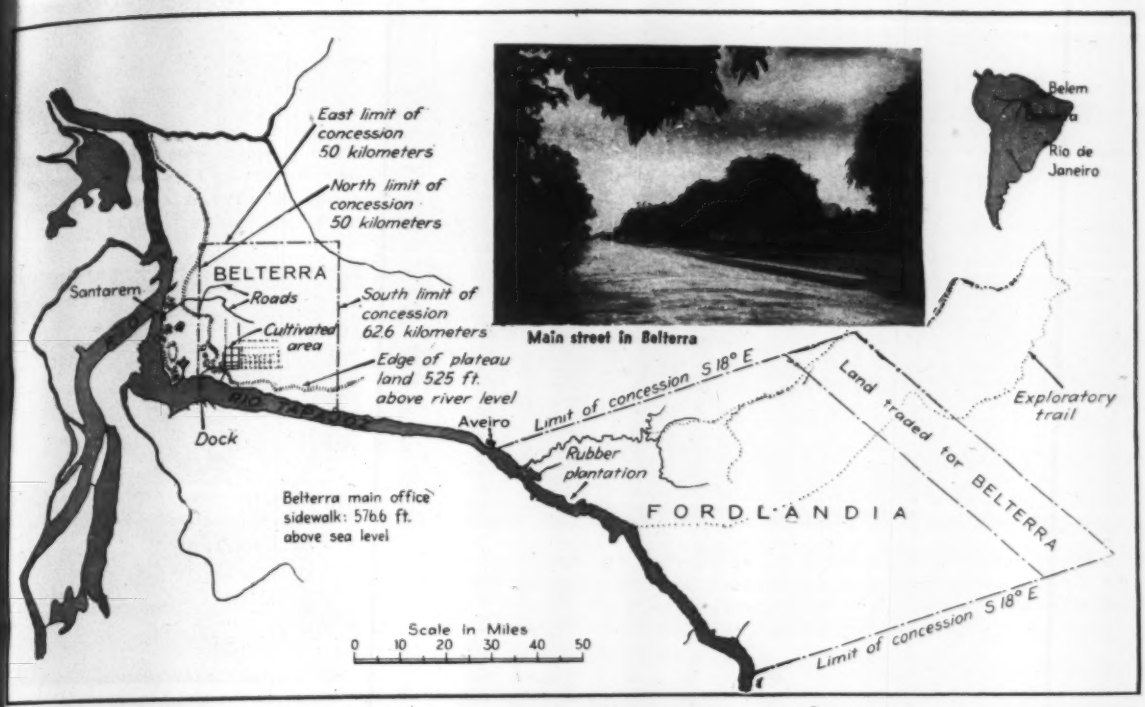



**Fig. 2. General layout of the plantation properties, located on the Rio Tapajoz, a tributary to the Amazon and 500 miles from its mouth. Initial operations were begun at Fordlandia, but activities now are concentrated at Belterra.**

servations led to reports based on fancy rather than fact, and as a result small encouragement has been given to visitors armed with notebooks and cameras.

This is only a guess, however, because my request to inspect the project was cheerfully granted by A. Johnston, managing director of the Ford Rubber Plantations. And when I finally reached Belterra, Brazil, every opportunity was afforded to see whatever I desired.

This is the background for the picture I got: The initial site selected for operations was the 2,000,000-acre Fordlandia tract, about 110 miles up the Rio Tapajoz, a tributary of the Amazon. In a period of six years some 7,000 acres of land were cleared and a million rubber trees planted. However, the terrain is quite hilly, making it very difficult to employ mechanical spraying and dusting equipment for the control of insects, and a more favorable site was sought for future development.

This more desirable area was found 80 miles closer to the mouth of the Tapajoz, at Belterra. Negotiations with the Brazilian government made it possible to exchange 600,000 acres of the undeveloped jungle land at Fordlandia for an equivalent concession at Belterra.

Since 1934, the major efforts of the Ford Company have been centered at Belterra. Here more than 17,000 acres have been cleared and 3,500,000 rubber trees planted. It is said that nowhere in the world is the terrain more favorable for large-scale agricultural development. The land, which is quite level, occupies a plateau 530 ft. above the level of the river. As a consequence the area is well drained and relatively free from mosquito breeding.

### Public works at Belterra

It was at Belterra that I observed engineering and construction practices that have provided the plantation with facilities that might well be the pride of any ably managed community in the States. And these facilities have contributed to the establishment of a standard of living far superior to any other that can be found in cities and towns of the Amazon basin. In this respect the enterprise has demonstrated the possibilities for creating healthful living and working conditions in a tropical region.

The inspection tour was made with Archie Weeks, who is in charge of engineering construction operations. He has been associated with the Ford Company for 27 years, the last fourteen years of which have been devoted to plantation activities. Mr. Weeks was one of the original group under whose direction the work was started in 1928.

The general layout at Belterra, he explained, is based on a division of the area into 1.5-mile squares, separated in most cases by 25-ft. wide access roads. Those roads selected to serve as the most direct means of thoroughfare between workers' villages, administrative headquarters, industrial and commercial centers, are made 32 ft. in width.

Termed first-class roads, they are surfaced with 4 in. of laterite. The latter is a residual, reddish soil containing hydrated oxides of aluminum and iron, and it is quite common in tropical regions, large deposits being available at Belterra. When it is rolled into place and wetted by rain, the laterite forms a relatively hard, smooth and durable surface. There are 49 miles of this type of road.

The so-called second-class roads—of which there are about 100 miles—are simply natural earth thoroughfares, bladed and rolled to a slightly

*Fig. 3. Heavy equipment employed in the construction and maintenance of dirt roads. Careful maintenance, including frequent painting, keeps the machines in tip-top shape despite exposure to tropical sun and rains.*

*Fig. 6. A stormwater catch basin made with reinforcing bars and concrete, the design of which is especially adapted for heavy, tropical rainfall.*

*Fig. 4. A well-equipped sawmill (at left) produces 75,000 bd. ft. of lumber monthly, the sizes including everything from flooring to heavy construction timbers. Native soft and hard woods, culled from areas being cleared for cultivation, are used with good results.*

*Fig. 5. Roads such as this one curving through a new clearing provide quick communication with all parts of the plantation.*

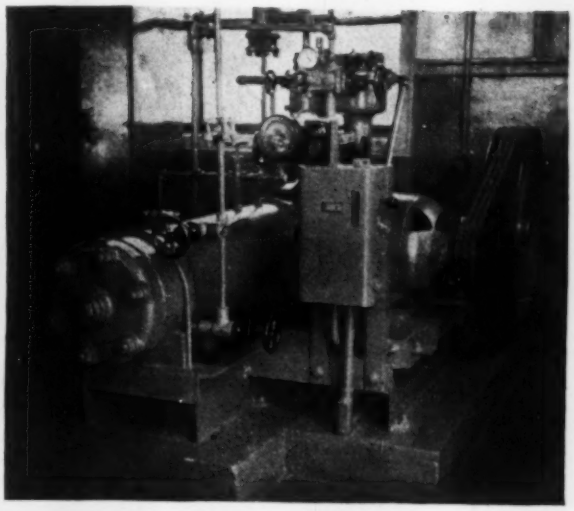


*Fig. 7. Power plant, which includes three 150-hp. diesel engines, each of which is direct coupled to 2,400-volt, 60-cycle, three-phase generators. Electric power needs on the plantation total 300,000 kw. hr. annually. Right: For food preservation in the village stores, ice is supplied from a central ice plant. This is the compressor for the 1-ton refrigeration unit.*

rowned cross-section. The soil absorbs water quickly and there is little need to provide drainage facilities except in a few places where steep grades prevail. Here side ditches with occasional wood diversion flumes are sufficient.

A crew of 15 men is constantly employed in maintaining the 150 miles of road that lead to all parts of the cleared and planted area.

### Housing and medical care

Present activities at Belterra are concentrated in a 17,000-acre section adjacent to the river, which is a relatively small part of the 600,000 acres available. While this represents only a fraction of the ultimate development, it has already involved the installation of many community facilities.

Housing needs alone have called for the building of 984 dwellings. Of this number, 650 are native-type straw houses, embellished with the addition of woodframe doors and windows. These houses are located in outlying villages, which are established as soon as new land is planted. They are replaced as fast as possible with permanent wood and tile roof houses, built to a standard design, 18x30 ft. in plan, and containing three rooms. Workers and their families, totaling over 8,000 at the present time, receive the use of these houses free.

General community buildings established in various parts of the 17,000-acre tract include seven schools (with a total enrollment of 1,250 students); three major churches, eleven general stores, butcher shops and three recreation halls. A day nursery is also provided for the convenience of mothers who occasionally may be engaged in farming or other light industrial tasks.

Administrative headquarters for the estate, which are located in an area that is reminiscent of a beautiful and well-kept park, contain the office and radio station, a dozen residences for the staff, a guest house, club rooms and a hospital. All of the buildings are of frame and clapboard construction, finished on the interior with wallboard.

The hospital commands special attention because there is no other like it, or with equal equipment, within a radius of at least 500 miles. A one-story building with a capacity of 100 beds, it is equipped with two operating rooms, X-ray and ultra-violet ray machines, a dental clinic and a pharmacy. An American surgeon is in charge, assisted by three Brazilian doctors and a large staff of nurses. Medical care, the same as with housing, is given free to all workers and their families. Prevention of, and treatment for malaria constitute one of the chief medical problems.

### Pure and adequate water

No less important for the maintenance of health, and just as impressive as the medical facilities, are the provisions for supplying and distributing pure water on the plantation. One would have to travel for thousands of miles in any direction from Belterra to find facilities equal to those installed here. (See *ENR* Dec. 23, 1943, p. 922.)

The source of supply is a spring at the base of the plateau, whose purity is vouchsafed by regular laboratory tests, none of which has ever shown the presence of *B. coli* as an indicator of pollution. The spring has been boxed in, and the supply pipe leads to the sump of a low-lift pumphouse. Here a 140-gpm. electric-driven centrifugal unit raises the water 80 ft. to a high-lift pumping station.

The high-lift station contains three electric-driven 140-gpm. centrifugal units and one steam turbine emergency pump. These pumps force the water 410 ft. higher to the plateau where it enters the distribution system. The latter includes two 50,000-gal. steel elevated storage tanks that "ride" on the line.

An artesian well supply has also been developed on the plateau for standby and emergency needs. The yield, however, is small in comparison to normal needs.

Some 35 miles of pipe ranging in size from 4 to 8 in. serve villages, commercial and industrial centers of the plantation.

Water is not piped directly into the homes of the laborers, however. Instead, the mains which are laid on one side of the road about 6 ft. from its edge, are tapped with a vertical riser and faucet at intervals of every fourth house. While this might not satisfy our standards of convenience, to the laborer in the Amazon who has previously spent hours every day in carry-

*Fig. 8. One of the 50,000-gal. steel elevated water tanks. Located at the edge of a clearing, it stands adjacent to a village "store" and community center.*

*Fig. 10. Every fourth house in the laborers' villages is served by a water tap. The availability of good water in unlimited quantities just a few steps from his abode represents a real luxury to the native, who enjoys a standard of living far above that of the average in the Amazon basin.*

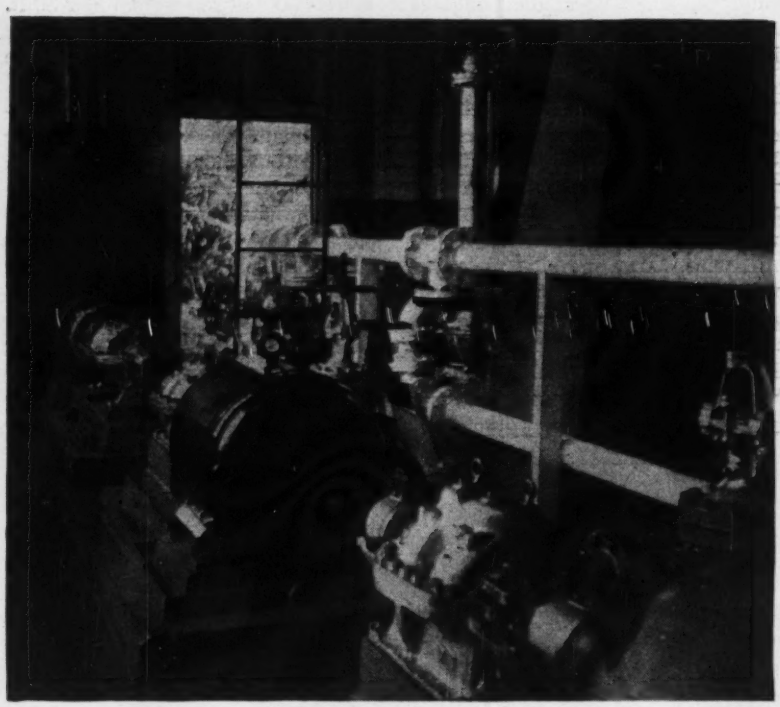


*Fig. 9. Through these pumps passes the finest potable water to be found anywhere in the Amazon valley. Three 140-gpm. centrifugal units lift a supply 410 ft. to the plateau where it enters the distribution system.*

*Fig. 11. To provide fire protection in the shop and warehouse areas the distribution system is well equipped with hydrants.*

Ford Co. photo

**2. Medical care is centered at this 100-bed hospital, which contains operating rooms, dental clinic and pharmacy.**

ater, the availability of a tap few steps from his door repre- an unheard of luxury. And important, every drop of water the tap can be used without the of contracting dysentery or d.

the least of the facilities to in- proper sanitation are those for e disposal. The buildings in the istrative area are provided with tanks and drainage systems, e workers' houses are served by . At no place is there a concen- of population large enough to more elaborate facilities than

### Electric power facilities

tric power is used extensively plantation for operating equip- s well as for supplying light, ual consumption of energy be- out 300,000-kw.hr. The power ting plant includes three 150- sel engines, each of which is coupled to a 2,400-volt, 60- three-phase generator.

smission voltage on the high- line, which is only 2¾ miles ecause shop facilities are con- ed, is 2,300 volts. For power ht distribution services trans- units provide 460, 230 and lts.

housed in the power plant g is the refrigerating equip- filters, compressor and brine sufficiently large for the manu- of one ton of ice daily. The sed largely for the preservation in the various stores located out the estate.

insure quick communication with all parts of the plantation a telephone system with 18 stations is in operation.

### Shops and equipment

Completely dependent on itself to handle any type of repair and new construction, Belterra is equipped with extensive shops and stockroom facilities. They are all located in one area, along with garages, latex processing equipment and the power plant, thus forming a small industrial center.

Thousands and thousands of items are stocked in the storeroom whose index and inventory system make it possible to find almost immediately what is at hand or exactly where it can be located. Everything from alum to Z-bars and from tacks to tractors are available to satisfy the demands that may arise at this outpost of civilization.

The shops, too, are called upon to exercise a wide range of versatility. For example, when the writer visited the woodworking plant he found one group making coffins of various sizes (about one a week is needed) while another crew of carpenters were engaged in building prefabricated timber trusses.

The several shops, all housed in buildings of concrete blocks, include machining, forging, woodworking, automotive and bicycle repairing and food processing facilities. The latter is concerned with the preparation of mandioca, a staple of diet in the tropics, which closely resembles farina cereal used in the States.

Mandioca flour is made from the fleshy root stock of a shrub widely cultivated in Brazil. The root bulbs, which look very much like large sweet potatoes, are first soaked in water to remove the coarse skin. Then the root is ground to a pulp, squeezed in a filter press and the solids dried in shallow, heated pans. The resulting material looks very much like sawdust (and to the writer tasted like it).

Speaking of sawdust, recalls the lumber mill on the plantation. The facilities here permit the production of about 75,000 bd. ft. of lumber monthly, and the sizes include everything from flooring material to heavy construction timbers.

Selected native soft and hard woods are used, culled from areas that are constantly being cleared for cultivation. In response to my query regarding the decay of timber under tropical conditions, I learned that native wood used by Ford is remarkably resistant and needs no special treatment. This was in contrast to early experiences with untreated pine and other woods imported from the States which, with the exception of cypress, were quickly destroyed.

### Construction machinery

The principal heavy construction equipment on the plantation included a ¾-yd. diesel-powered shovel, two patrol graders, a steam roller, a 16-hp. bulldozer, two small concrete mixers and a concrete block machine. In addition, there was a wide assortment of small tools and a modest fleet of light trucks. Although the equipment was mostly ten or more years old, it was clearly evident that it had received the best of care and maintenance. Frequent painting, for example, had completely protected the metal work, de-

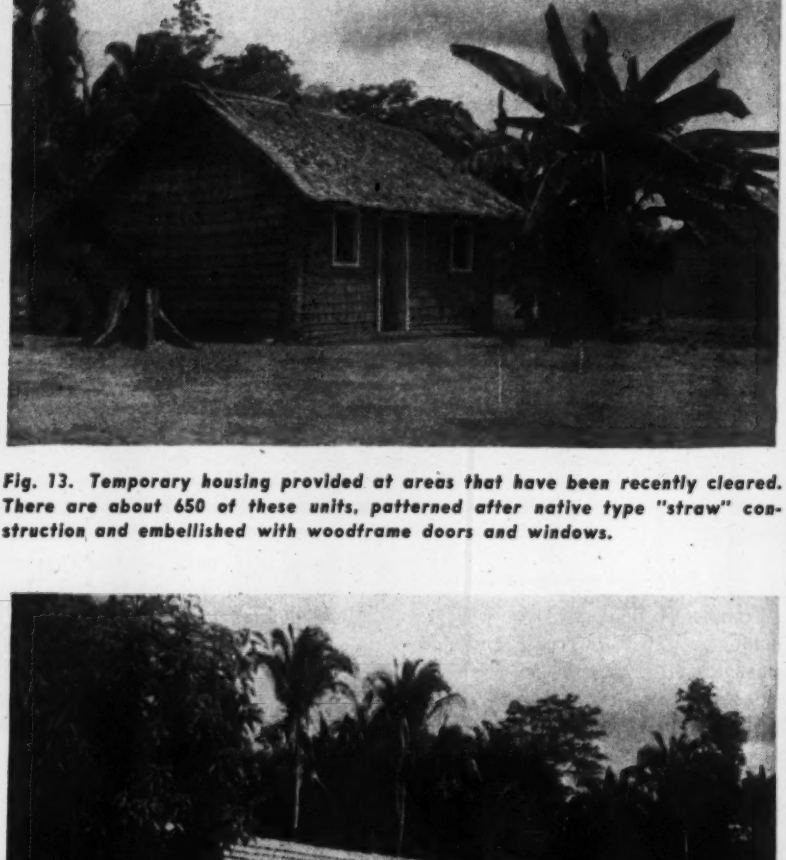


*Fig. 13. Temporary housing provided at areas that have been recently cleared. There are about 650 of these units, patterned after native type "straw" construction and embellished with woodframe doors and windows.*



*Fig. 14. Permanent wood frame and tile roof houses, built to a standard design, eventually replace the straw-type units. Each house contains three rooms. More than 8,000 workers are accommodated with free housing at the plantation.*

spite the fact that the machines are stored in the open and subject to the ravages of a humid atmosphere and burning sun.

### Rubber cultivation activities

All this equipment, the planning and the building, focuses attention on the manner in which rubber is cultivated.

The first step, of course, is to clear the land of its jungle growth and make it ready for planting. Areas to be cleared are subdivided into 40-acre blocks, and 20 laborers are put to work at "underbrushing." This operation involves the cutting of saplings, vines and similar growths up to 2 in. in diameter. Then the trees are felled, using hand axes to cut the trunks about 30 in. above the ground.

After the branches are lopped, the block is left to dry for 90 days after which the area is "fired." This does not necessarily result in complete burning of the tree trunks, and it is preferred to let the trunks rot a (which often takes many years) to burn too intensely and thus de the humus and other valuable food materials in the soil. Burni confined to a period of two to weeks before the advent of the season, which begins in Decembe Belterra.

After a block is burned, it is s at 15-ft. centers, the stakes indic where seeds are to be planted. the five or six seeds in each hill always found that two plants wi more vigorous than the rest aft period of four months; the sp plants are then destroyed and o permitted to grow undisturbed f year. Each acre of land, when pla has 220 rubber trees, but in the el nation of poor trees over a five- period, the number is eventuall duced to about 100 per acre.

### "Building" a good tree

The one-year old trees underg extraordinary regimen in order t velop specimens that are high yiel in rubber as well as resistant to blight. First, the young tree, w has a trunk about one inch in dia ter, is grafted with a "bud" t from nursery stock of proven yield quality. The graft is made to the body of the trunk, and if bud takes hold within a month parent tree is cut back almost t bud. The budwood of the high ing trees grown in the nursery r sent the 52 finest specimens sel from 800 million trees culled on tations in the Far East.

In another year when the comp tree has grown to a height of a 6 ft. a second graft is made sli below the point where the bra take off from the trunk. The bud for this graft comes from other ery stock that has shown its abil resist the attacks of leaf diseases.

In this fashion, a composite, "t in-one" tree is developed of whic root system is of native Amazon s the trunk is a descendant of a yield rubber tree, and the crow resistant to leaf blight.

"These composite experim buddings have grown very rapi stated Dr. J. A. Zillies, agricul expert on the plantation, "and 1941, five years after the experi were begun, the first trees brought into tapping. Records the ability of such composite tre

ne up to the highest standards of ld. This year will find the entire ntation at Belterra budded with ease-resistant trees capable of lding from 8 to 10 lb. of rubber tree per year."

Eventually it is expected that seeds l become available from which the l rubber tree for the Amazon re- n can be propagated. One must be ient, said Dr. Zillies, because it es almost ten years to determine yield characteristics of a particu- tree.

### Tapping and shipping

Plantation trees are not tapped until are seven years old and have ched a diameter of 7 in. (at a point . above the ground). The tap is de by cutting a helical slot around tree with a sharp curved knife. at care is exercised in this oper- n not to injure the cambium, or r layer of cells, which lies between bark and the wood. The life of tree depends on preserving this bium layer.

When the cut is made, the latex s in the bark are severed, and the te latex flows down the slot into a fastened at the low point. The cut is shaved back every third day to en the tubes, which close after a hours flow because of the natural gulation properties of latex.

he latex, which is a rubber emul- containing about 70 percent wa- is then brought to the central proc- g plant where it is "creamed" packed in 5-gal. oil tins for ship- t. The creaming process involves addition of a chemical agent that es part of the water to separate the latex without disturbing the lsion. In this manner the water ent is reduced to 40 percent as pared with the original volume of ercent, and a great saving in ship- space results.

ubber in creamed form is said to far superior to the coagulated uct, which is formed by smoke ment of the latex. For fine rub- goods, such as surgical gloves, and he permeation of tire fabric, the ned latex emulsion is unexcelled; the latex has been coagulated it never be restored to its original sified form.

### Amazon rubber and the war

cording to D. H. Stallard, acting ger of the plantation, production in 1943 will be about 500 tons. But with an increasing number of selected trees reaching the tapping stage, it is confidently expected that by 1950 the production will reach 5,000 to 6,000 tons yearly.

When the Far East rubber plantations were taken by the Japs, our principal source of this vital war material was cut off. This led the United States to initiate action in the Amazon basin, the original habitat of rubber, to promote production.

These efforts in Brazil, sponsored

Ford Co. photo

***Fig. 15. General community buildings, which are built in central parts of the plantation, include three major churches. Two of these are for Catholic worshippers, and the third is for Methodists.***

***Fig. 16. Shops and stockrooms are housed in concrete block structures of the design illustrated here. The time-clock promotes labor efficiency.***

*Fig. 17. A cleared area in which three-year-old "composite" trees are flourishing. Remnants of the jungle trees that were felled can be seen rotting away on the ground; they are not burned because this would destroy soil humus.*

Ford Co. photos

*Fig. 18. After an area is cleared, it is staked at 15-ft. centers, and rubber tree seeds 5 or 6 to a hill are planted. Right: A "tap" is made by cutting a helical slot around the tree with a sharp-curved knife. When the cut is made the latex tubes in the bark are severed, and the white latex flows into a cup.*

large measure by the U. S. government's Rubber Development Corp., bear no relation to the operations conducted by the Ford Company, however. The Ford enterprise, centered around the long-time development of plantation rubber was started more than a decade before the war. The RDC, on the other hand, has been concerned with increased production from wild rubber trees.

Among other things, the RDC in cooperation with Brazilian government authorities has had to move workers far up the Amazon, outfit them and make arrangements to supply food and medical care. At first it was believed that these efforts would be the forerunner of a boom in the valley, such as was experienced three decades ago when Amazon rubber was a dominant factor in the world market. But this dream has not come to reality. Great difficulties are being experienced in mobilizing labor, food supplies are scanty and it is reported that relatively little rubber has come out of the jungle thus far, despite a comparatively large expenditure of money.

In some respects, this sudden interest in rubber in the Amazon has been detrimental to the Ford operations. "Bonanza" stories have circulated along the river that rubber tappers can make 50 milreis a day (about $2.50); Ford pays 11 milreis for an eight-hour unit of work. This has created some labor unrest at the plantation, and at present there is a shortage of workers. In fact, if Ford could get 10 more tappers, it would be possible to increase production by about 25 percent.

Mr. Stallard discounted the 50 milreis a day story, citing information from some of his former tappers who had returned disillusioned from their up-river experiences. They reported that their wages actually were based on 60 percent of the rubber collected, and that they suffered great hardships in "working" the wild trees. Furthermore they had to pay exorbitant prices for what little food was available in the upper Amazon regions.

"I hired back these fellows," said Mr. Stallard, "not only because we needed skilled help but with the added hope that their story would convince the other workers of the desirability of staying on the plantation. Here they not only get a guaranteed wage for each unit of work but they can purchase all their food at or below cost and we provide free housing and medical care."

### A public service enterprise

From both the economic and humanitarian point of view, pointed out Mr. Stallard, there is no question about the merits of producing rubber on a plantation basis.

"Tapping of wild rubber," he said, "entails tremendous hardships, and even under the very best conditions a man can obtain only 1,400 lb. a year. That same tapper, however, will be able to produce 6,000 to 8,000 lb. per year working on a plantation."

It takes time and money, however, to get a planation into operation. This is evidenced by the Ford operations on which some $6,000,000 has been expended since 1928. Virtually all of this has gone into developmental work and the installation of permanent facalities representing capital investment, and from which no immediate return could be expected.

Measured in terms of rubber production alone, it probably would be correct to state that the Ford plantation cannot yet be considered a commercial success. However, in making a broad appraisal of this project the yardstick should also scale values that are not immediately evident. For example, this pioneering venture in the Amazon basin is proving the possibilities for development—by private enterprise—of a tropical region whose resources hold great promise for future activities.

Furthermore, from a purely altruistic viewpoint, the project is a notable demonstration of the "good neighbor policy" in action. The sincere and productive efforts of the Ford Company in introducing to this region standards of living far beyond anything it had known before, stands in striking contrast to many situations in South America wherein foreign capital has left a sorry record of exploitation.

From the viewpoint of the engineer, this transformation of a jungle area into a community complete with all the amenities for productive and healthful living is another vindication of his role as a vital contributor in making the world a better place in which to live. Every engineer has been imbued with this philosophy, but many times his more monumental achievements fail to reveal its direct application. At Belterra it becomes realistically evident.

***Fig. 19. A typical "village store" at Belterra. Food, clothing and other merchandise are sold at controlled prices by merchants who have been granted concessions and operate under company supervision.***

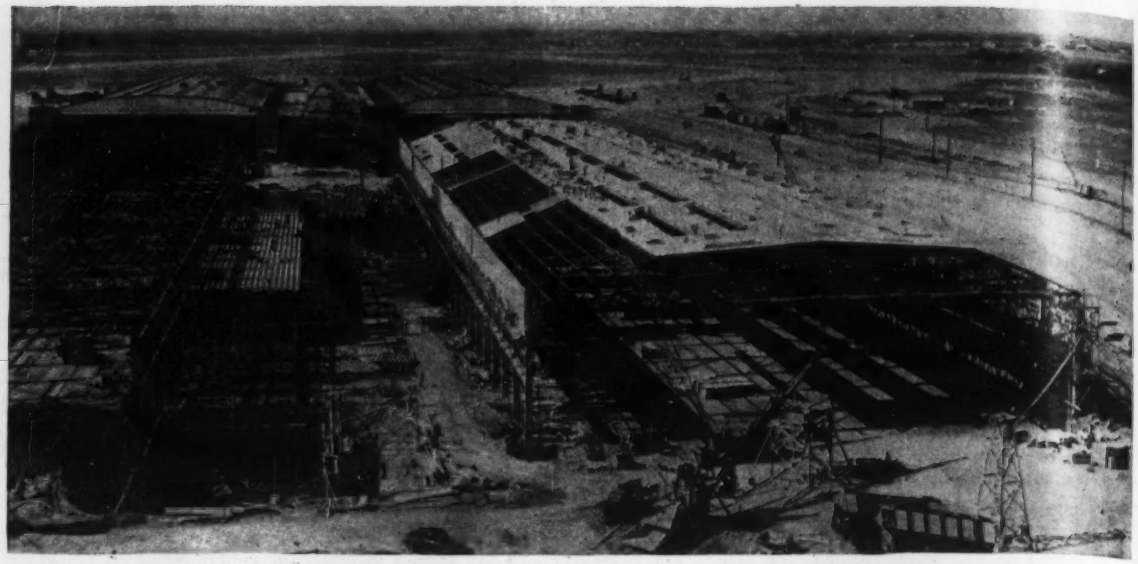


*Fig. 1. Status of work 75 days after contract was awarded. Structures in background were in use 65 days after award.*

# Plane Modification Center Designed And Built in Four Months

***Contents in Brief**—An airplane modification center providing 624,000 sq. ft. of floor area was designed in three weeks and constructed in 92 days. Design chosen for the four 160x600-ft. hangars required reinforced-concrete columns, concrete-block walls, and a steel-truss roof covered by gypsum plank. A reinforced-concrete column and beam design was used for the intermediate offices and shops. The rapid construction was accomplished with a maximum force of 1,800 workmen.*

A RECENTLY COMPLETED modification center in Oklahoma is of interest because of the design adopted and the construction procedure followed to permit early completion of the project. What is considered a new speed record for a building of its type resulted, 622,700 sq. ft. of floor space being provided in 92 days after construction started. Detailed design and preparation of working drawings required three weeks.

Facilities for the modification and repair of large bomber and fighter airplanes were needed. Two similar structures, each consisting of two 160x600-ft. hangars separated by a two-story 100x600-ft. shop and office building were to be provided. The general layout required that the structures be placed 300 ft. apart and end to end in the north-south direction.

Four general designs considered were: (1) a timber-frame structure, including the roof trusses; (2) a rigid-frame, reinforced-concrete design; (3) hangars with thin-shell, barrel-type roofs; and (4) hangars with concrete columns and steel truss roof framing.

A survey to determine materials available for early delivery revealed that a local fabricator had on hand sufficient steel for fabrication of the hangar trusses, provided light shapes were used. In contrast a shortage of structural timber in long lengths was revealed, which could be expected to delay completion of a timber-frame structure 30 days longer than for a steel-truss layout.

Studies made by the district office of the U. S. Engineers as to expected construction progress showed that sufficient forms for one and one-half buildings would be needed for rapid construction of a rigid-frame concrete structure. The studies also indicated that form lumber requirements made this design the least economical of all proposals and that this layout would require 30 days more construction time than a steel-truss design. In the same way construction of a barrel-arch hangar in the allotted time was expected to require six sets of forms, which made this design less economical than the steel-truss hangars; also completion might be delayed a month longer than if the steel trusses were used. Since major emphasis was on speed, the steel-truss layout was chosen. Value of this choice was proved by the rapid construction that followed, despite a shortage of skilled labor, bad weather and heavy rainfalls, and slow delivery of electrical items and other equipment.

The final design chosen for the hangars called for: Spread footings; unreinforced-concrete floors; 18x24-in. concrete columns on 25-ft. centers longitudinally; 12-in. thick concrete-block walls broken up by a 10-ft. high band of wood-sash windows;

160-ft. steel roof trusses of light design on 25-ft. centers, and a 2-in. gypsum roof supported by bar joist purlins on about 6-ft. centers and covered by a two-ply, mineral-surfaced felt. Steel-frame doors fabricated in 16-ft. wide vertical panels were specified for the ends of the hangars. The doors slide on light railroad rail into concrete pockets that form the pylons at each side.

### Column and girder design for offices

For the two-story shop and office space between hangars a reinforced-concrete column and girder design with 16x18-in. columns on 25-ft. centers each way was chosen. The ground floor was to be unreinforced, the second floor and flat roof of pan construction, the outer walls of concrete-block, and the inner walls of hollow-tile. An exception to the latter is an 8-in. thick brick firewall between the east hangar and the shops and offices.

Heating of each building is by four gas-fired forced-draft units each of 6,000,000-B.t.u. hourly capacity. These units, which are considered the largest of their type ever constructed in the United States, may be changed in less than two hours into coal-fired heaters. They are located in two basement rooms, one at either end of the structure.

Hot air from the heaters is distributed by exposed metal ducts leading to overhead diffusers. In the hangars the diffusers are located in the plane of the lower chord of the roof trusses or 35 ft. above floor level. In the offices and shops they are about 10 ft. above floor level and on 25-ft. centers. An exception to this arrangement is the discharge of hot air from a floor duct a few inches inside of the end doors of the hangars.

### Lighting gets much study

The artificial lighting system for the hangars received much study. Two major requirements were: (1) A minimum of 35 foot-candles to be available 4 ft. above floor level, and (2) light provided be similar to daylight and of a type to aid in obtaining the precision work required and in reducing accidents.

The artificial lighting chosen for the hangars consists of a combination of incandescent and mercury vapor units. These lights, suspended at the level of the lower chord of the trusses, consist of units made up of one 1,000-watt incandescent lamp and two 400-watt mercury vapor lamps spaced on 20 by 25-ft. centers. To improve both daylighting and artificial lighting, the top $\frac{3}{4}$ in. of the floor was constructed with a concrete made with white cement. Tests of the lighting system in the hangars, which was installed with exposed wiring, showed that 36 to 41 foot candles at the 4-ft. level were available.

In the daytime sufficient light is obtained in the hangars through the obscured-glass windows in the sidewalls, and by skylights containing corrugated thermal shock-absorbing glass. In each hangar 48 skylights are used, 36 measuring 5x63 ft. and 12 measuring 5x37 ft. The skylights are of a timber-frame and timber-sash design.

Lighting requirements were not as severe for the offices and shops. Monitors with wood sash provide some daylighting on the second floor in this area, but for the most part artificial lighting is used. This system consists of 100- and 200-watt incandescent units suspended 10 ft. above the floor on 25-ft. centers. The wiring system in the offices and shops is concealed.

In the hangars the piping to supply compressed air was carried down the columns to outlets a few feet above floor level. Electrical power outlets also were made available at each column a few feet above floor level. No floor outlets were provided.

### Rapid construction required

Detailed design of the buildings was sufficiently rapid that the project was ready for the advertisement of bids 24 days after it was authorized.

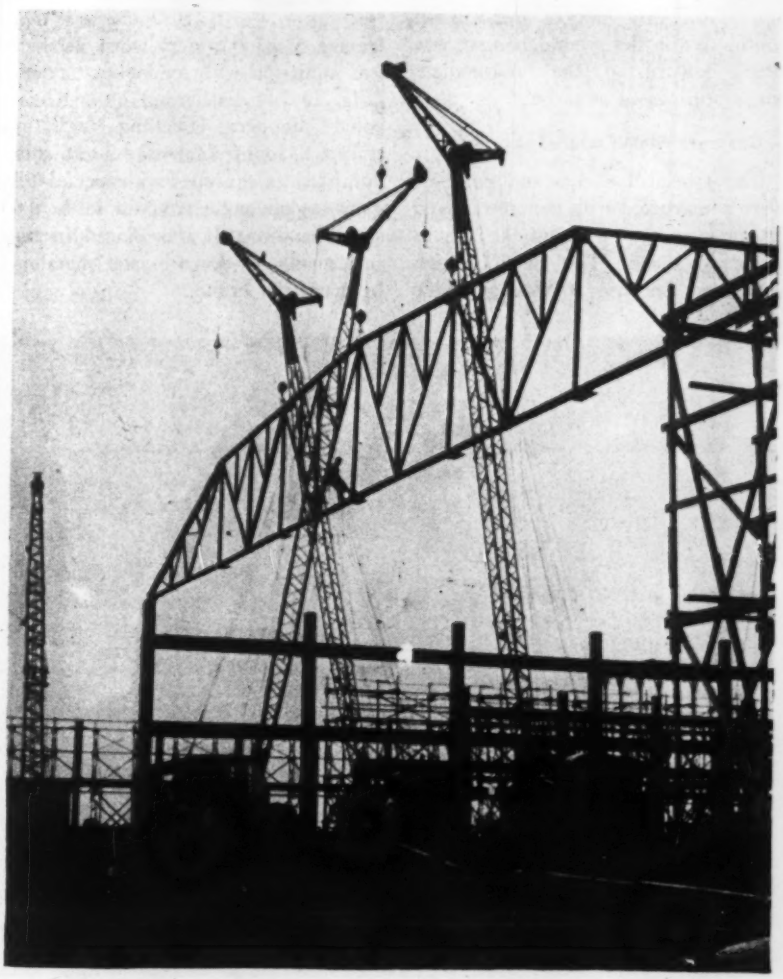


***Fig. 2. Three cranes erected the first 160-ft. roof truss of each hangar and then two cranes the others at a rate of four to five daily. Trusses were delivered in four sections and spliced on the ground with rivet bolts.***

The contract was awarded 8 days later. Extremely rapid construction was specified, the south building to be ready for occupancy in 66 days and the north structure one month later.

To meet this schedule, the general contractor concentrated on one building at a time. Two possible methods of construction considered were: (1) Construction of the center or office and shop area first, and then erection of the steel trusses for the hangars; and (2) redesign of the exterior columns of the center section as free-standing to permit earlier erection of the hangar trusses. Because emphasis was on speed, the latter method was chosen, permitting the use of larger crews on more simultaneous operations.

The construction crews started at the south end of the east hangar and worked north. When the construction crews reached the north end of this hangar they transferred to the same end of the west hangar and worked south. While the second hangar was being constructed, the intermediate shops and offices were built.

#### Concrete manufactured by paver

The spread footings and columns were constructed with concrete mixed by a paver moved about the job as work advanced. The paver, which was used because it was available from a nearby project when needed, was equipped with an inclined boom (Fig. 1). It discharged into an elevated hopper. Lacking agitator trucks, the contractor used 2-ton, end-dump trucks equipped with special tail gates to deliver the concrete to the desired location. It was placed in the forms with lay-down buckets handled by a crawler crane.

***Fig. 3. Hangar lighting consists of one 1,000-w. incandescent light and two 400-w. mercury vapor units on 20x25 ft. centers.***

A different distribution method was used in constructing the second floor and roof. Concrete for this floor was delivered by the inclined boom of the paver to a floor hopper, from which it was distributed by buggies. Concrete for the roof was raised by means of a wood tower and delivered to the forms by the buggies.

High-early-strength cement was used for all structural concrete. The early setting that resulted permitted the forms to be stripped about two days sooner than if ordinary portland cement had been used.

All the forms were built of ¾-in. plywood at a central plant. Because of the required construction speed on the south building, it was possible to use the forms for the exterior columns and spandrel beams but twice. A complete set of floor and roof forms was fabricated for the entire center section of the office and shop area. Time did not permit re-use of these forms. This procedure required over 5,000 posts for shoring.

#### Steel erection completed in two weeks

Arriving on the job in four sections, the roof trusses were assembled on the ground and lifted into place as a unit by two crawler cranes with 65-ft. booms and 10-ft. jibs. The two cranes erected four or five trusses each day, all steel erection being

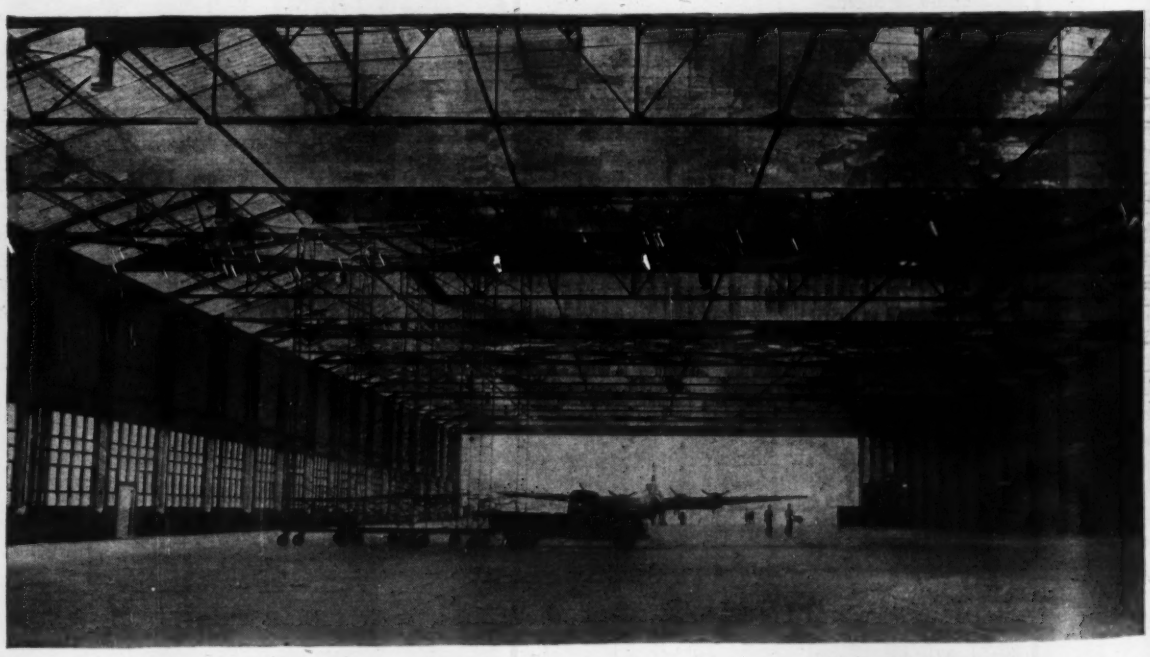


***Fig. 4. Draft curtains were added at every other hangar roof truss. To improve lighting conditions, white cement was used in the top ¾ in. of the floor.***

leted in two weeks. The sections of riveted construction, but the joints were made with rivet bolts se sufficient riveters were not able.

aft curtains were added at every truss or on 50-ft. centers. The ins were made of corrugated when this material could be ob-, but otherwise of sheet metal.

**Floor built under roof**

nstruction of the hangar floor d after the roof was complete. loor was designed for a 60,000- heel load. It consists of a 10½- in. unreinforced slab built in widths with a paver. Expansion divide the floor into 80 x 100- tions. A concrete with a mini- compressive strength of 4,500 as used.

provide a firm bearing for the lab, the top 6 in. of the sub-base carified and compacted to 95 t modified A.A.S.H.O. density. 8-in. of blended base course ial was added in two 4-in.

material consisted of 50 per- rushed rock, 30 percent sand, 0 percent quarry fines. It was cted in place at optimum mois- ontent to 95 percent modified .

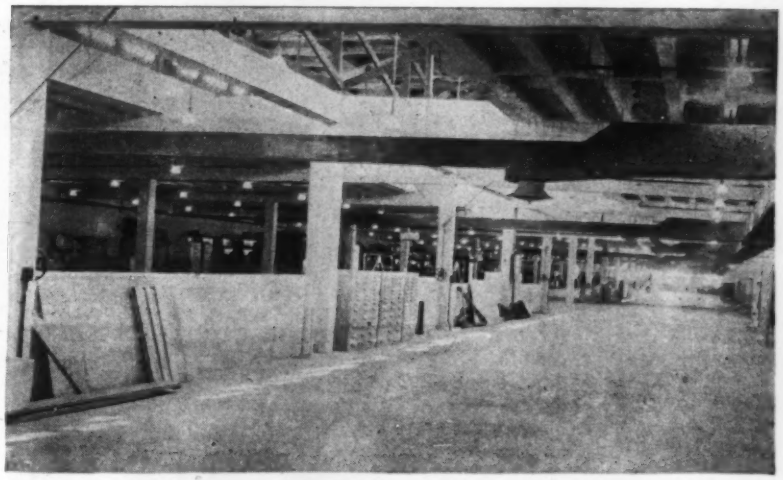
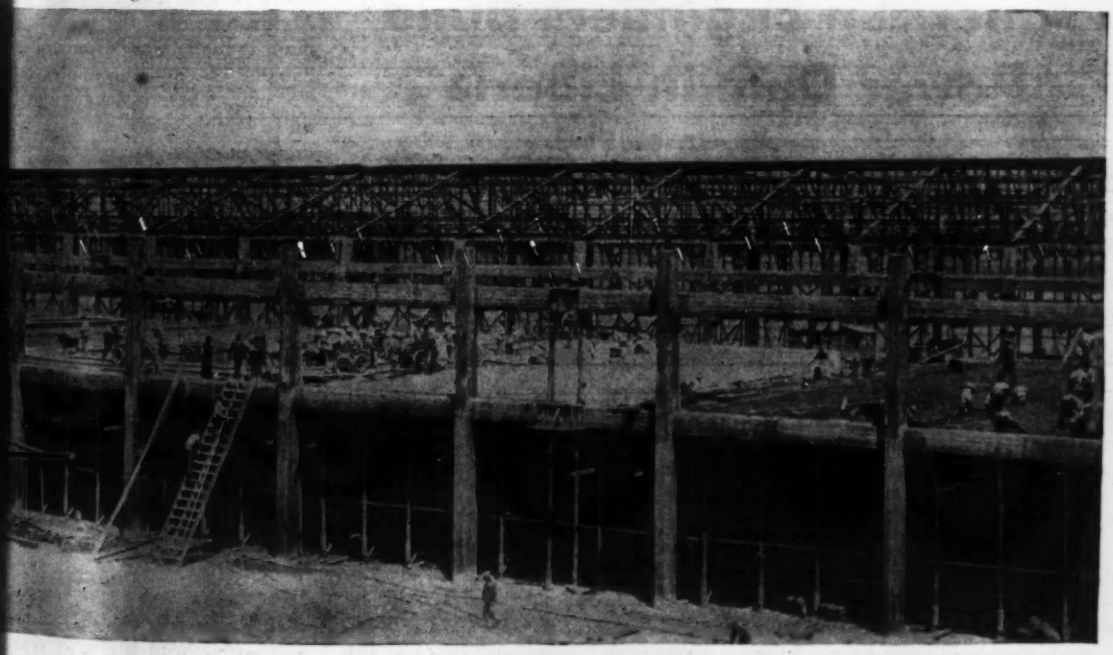


*Fig. 5. Heating of shop and office area between hangars is by exposed ducts suspended from ceiling leading to distusers.*

Construction operations continued 24 hr. a day, except for steel erection, which was carried on during daylight hours only. A maximum construction force of 1,800 men was used by the contractor. His crew averaged about 1,500 men for several weeks.

Cost of the work was about $4,500,000. It was supervised by the Tulsa, Okla., district of the U. S. Engineer Department, under the direction of Col. F. J. Wilson, district engineer. Lt. Col. D. P. Grosshans is chief of the engineering division, E. C. Franzen, head of the design branch, and Capt. John Soderberg area engineer. Sverdrup & Parcel, St. Louis, and J. Gordon Turnbull, Cleveland, were architect-engineers, with William Lorenz resident engineer. Corbetta Construction Co., New York, was the general contractor. For this organization Harold Murray was project manager and Frank La Morte general superintendent.



*. Central office and shop area between hangars was constructed simultaneously with the hangars. Rapid schedule met did not permit reuse of forms.*

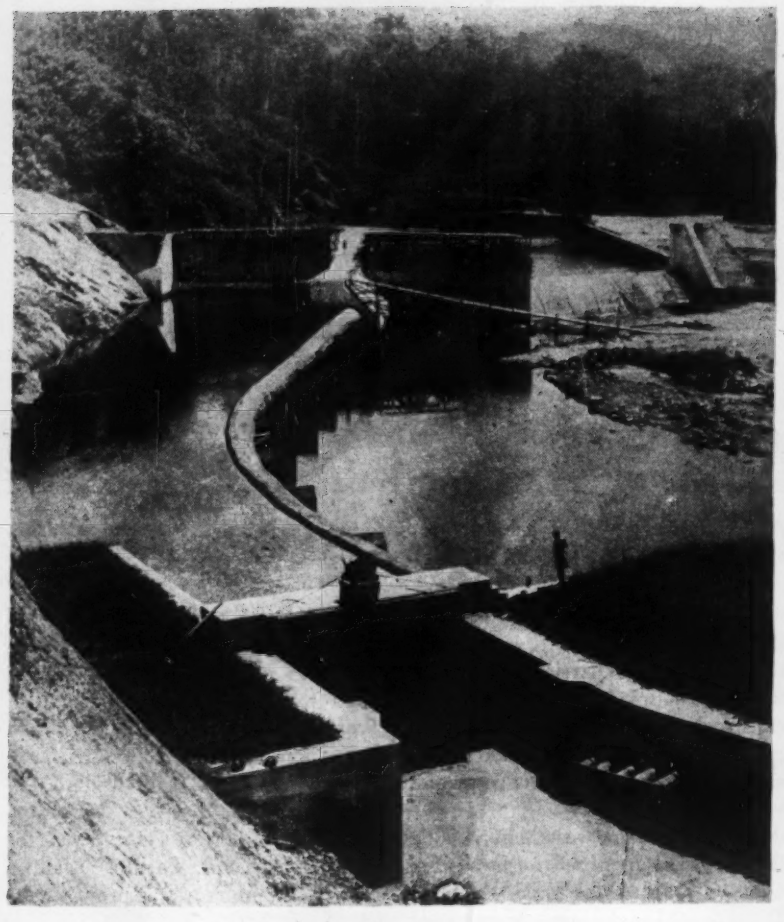


*Fig. 1. Because of the wide variation of river flow between dry and rainy seasons, long spillways were provided, including a side-channel spillway along part of the intake canal.*

# American Engineers Build Power Dam in Liberia

***Contents in Brief**—A West African hydro-electric project was constructed under severe conditions almost entirely by native hand labor. Normal river flow is diverted by a low ogee dam through several hundred feet of open canal to four steel penstocks leading to a powerhouse, where American-made generating equipment has been installed.*

THE FIRST HYDRO-ELECTRIC power project ever constructed in Liberia, West Africa, was recently designed and built by Firestone Plantations Co., under the supervision of their engineers. Since it provides power for the 100,000-acre development of the company, a subsidiary of Firestone Tire & Rubber Co., the project is aiding in the production of a vital war material, rubber. When additional generating units are installed, the project will prove of still greater importance.

Although not large in size, the project has called for much difficult construction in a short time under severe working conditions. Access roads through jungle terrain were required. Construction activity in the river was limited to the dry season of a few months duration, rainfall being as much as 30 in. in some of the rainy months and 125 in. for the entire rainy season. Much of the material and equipment had been purchased just prior to our entry into the war; however, the delivery of these items from sources thousands of miles away, which would be a major problem in peace time, became much more difficult under wartime conditions. In addition, all material had to be unloaded on open sea into small boats for transporting to shore. Also, although Liberia is about the size of the State of Ohio with a population of nearly one million, skilled labor was lacking and untrained native hand labor had to be used almost entirely.

A general plan of the project is shown in Fig. 2. It includes a diversion dam 1,100 ft. long, an intake and headworks, a 500-ft., side-channel spillway, 2,500 ft. of open canal of 10-ft. bottom width, four 7-ft. diameter steel penstocks each 230 ft. long and a 36x75-ft. steel-frame and brick powerhouse of a size to accommodate four 938-kva. units.

The project is located about 2 miles from the mouth of the Farmington River, one of the largest rivers in northern Liberia. This stream drains a mountainous region in which a wide range of flow occurs. At the dam site, the probable maximum runoff was estimated to be 250,000 cfs. and the minimum to be 320 cfs. These estimates were based on a single year of gage records and a thirteen-year record of precipitations over adjacent areas.

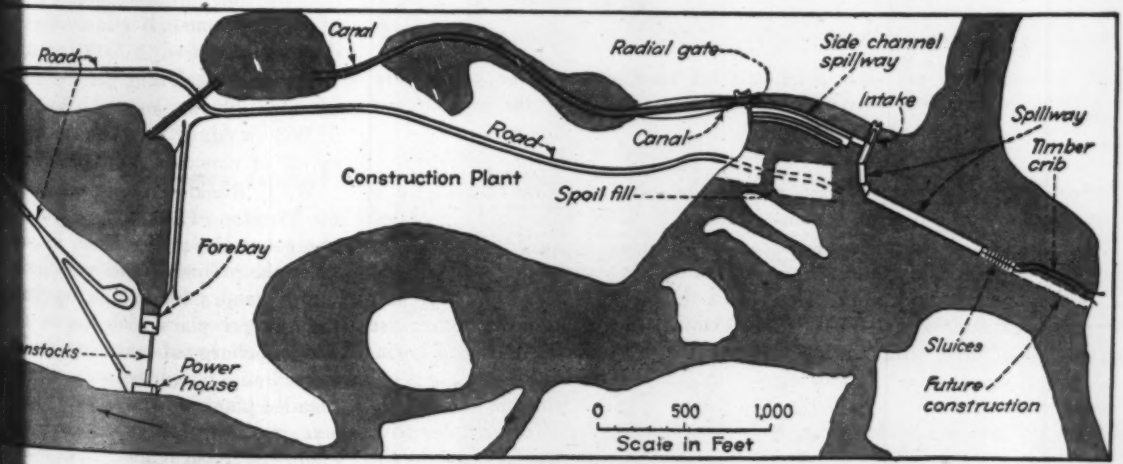
Construction of the diversion dam because of the heavy flows and the foundation conditions encountered proved most difficult. Average height of this ogee structure is 15 ft. It is founded on granite rock with layers of silt and mica extending through the stone in many places. Work was carried on within earth-filled cofferdams built of logs cut nearby. In one portion of the dam, two cofferdams were destroyed before the concrete work was completed. Because of the urgent need to place the plant in operation, another section of the dam was built as a temporary timber crib, which will be replaced as soon as possible with a gravity type concrete structure similar to the completed portion.

The work of building the side-nnel spillway within the coffer-s was a laborious process. After material had been loosened with losives, it was broken up by hand sledge hammers to a size which native laborers could "head-load" "wheelbarrow" from the founda-areas. The only mechanical h-moving equipment available isted of a single bulldozer, one ving scraper, and one shovel. A proportion of the earth exca-n was accomplished by mattock shovel with wheelbarrow hauls o 400 yd.

onstruction of the side-channel way and adjoining buttresses also a major problem because of dation conditions. Excavation his construction revealed a ma-of lower bearing value than ipated. As a result, it was nec-y to change the design from a ty section to a hollow structure. ncrete for the dam and spillway ther nearby structures was man-ured by a central plant at the truction site indicated on the al plan. It was delivered in buckets hauled to the dam by and swung to the delivery point crawler crane, or in 1-yd. trucks, dumped directly into the forms. al thousand yards were also by wheelbarrow. A 3,000-lb. ete with a 4-in. slump was speci-for the mass concrete, and a -lb. concrete with the same for the remaining work.

shed rock aggregate was used. s produced by an American-gyratory plant set up near the site. Sand was obtained near the mouth of the river, being delivered by barge and truck. Cement was purchased in barrels and bags from the United States and England. Reinforcing and structural steel was obtained from this country, as was most of the required lumber. Brick for the power house was produced from local clay at an American brick plant set up in the field and operated by native workmen.

***Fig. 2. The original plan was to construction the side-channel spillway as an ogee section, but excavation revealed low-bearing foundation material that made hollow-buttressed construction of this type more satisfactory.***




***The Farmington River was dammed with low overflow weirs of concrete, a series of sluice gates and a timber crib. tter will be replaced at a later date. From behind this dam, water is led to the powerhouse through an unlined nd pools formed at the natural low elevations.***

*Fig. 4. Excavation for the canal was done largely by several hundred natives with wheelbarrows. The canal was left unlined.*

*Fig. 5. Although only one generating unit has been installed, the powerhouse was built large enough to accommodate four units. Brick for the building was made locally.*

Native hand labor, aided by a crawler crane equipped with a clamshell bucket, performed some of the heavy excavation for the canal, which was about 25 percent rock work. This waterway was approximately 10 ft. wide at the bottom, with an inside wall slope of one to one. It was left unlined. Normal flow from behind the dam to the canal is through two steel-lined, 11-ft. square orifices into a channel behind the 500-ft. side spillway and then through a 16x20-ft. concrete structure in which a radial gate is installed. The radial gate is normally wide open and is closed only when an emergency necessitates unwatering the canal. The orifice and side-channel spillway provides greater flexibility in operation than otherwise possible, by reducing the head variation. In conjunction with the fixed orifices it also protects the earthworks downstream from the excessive flood stages expected to occur at the dam.

The 7-ft. dia. penstocks leading from the canal to the powerhouse are supported on reinforced concrete piers and the ends are anchored in concrete. These penstocks were constructed of $\frac{5}{16}$-in. thick steel pipe fabricated in the United States, the sections being joined in the field with power driven rivets.

Built by local masons and steel workers, the powerhouse proved less difficult to construct than the dam. The first of the four 938-kva. units to be housed has been installed and placed in service. It is driven by a Francis type turbine and delivers power at 2,400 v. The average effective head available is 69 ft., and the probable minimum is 52 ft. When the other three units, which will be of the same capacity and operate under the same conditions, are added, the maximum water demand will be 800 cfs.

Rigid specifications were required for all the electrical equipment to protect it from high temperature and humidity ever present. Voltage was generated at 2,400 v. and transferred to 13.8 kv. for transmission, the generation being done at the lower voltage because of the high humidity conditions. Other major electrical problems involved the design and installation of the best possible lightning and surge protection equipment. This measure was necessary because of the heavy and frequent lightning discharges in the area.

During the peak construction period about 1,600 native laborers were employed directly on the project, and hundreds of others on supplementary tasks. Their work was supervised by a staff of ten American engineers. Construction continued over a period of two and one-half years. Work to date has required 163,000 cu.yd. of excavation, including 34,000 cu.yd. of rock work, and placement of 57,968 cu.yd. of earthfill and 29,653 cu.yd. of concrete.

W. T. Runals as chief engineer of the Firestone Plantations Co. was in charge of the project. K. V. Jones made the preliminary surveys, including hydrographic studies, prepared the general plans and was in non-resident charge of construction. J. L. Farrell supervised the preparation of detailed plans in Akron. M. F. Tandy was resident project engineer in charge of construction. R. E. Wilson, formerly resident plantations chief engineer, is now general plantations manager in Liberia.

# Historic Water Supply Manuscript in Bombed Monastery of Monte Cassino

**M. N. Baker**
Associate Editor (Retired), Engineering News-Record
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DESTRUCTION by American bombs of the historic monastery of Monte Cassino, Italy, brings to mind the fact that within its walls there was preserved for many centuries a manuscript of great engineering importance. This was the "Two Books on the Water Supply of the City of Rome," by Sextus Julius Frontinus, Water Commissioner, A.D. 97.

The original of this document was the first known description of the waterworks of a city written by the official in charge. Eighteen hundred years after it was written, the noted American hydraulic engineer, Clemens Herschel, to whom for many years a study of Frontinus had been a pastime and hobby, made a "pious pilgrimage" from New York to Monte Cassino to examine the manuscript.

As a result of this pilgrimage there was published a photographic reproduction of the "sole original Latin manuscript," a reprint of a Latin text, an English version by Herschel and several illustrated explanatory chapters. The book was brought out in 1899 by Dana Estes and Co. of Boston as a handsome quarto.

All other existing manuscripts and printed copies in existence, wrote Herschel, can be "traced back to the precious 22½ pages of parchment of Frontinus' *De Aquis*, originally written and still kept in the library of Monte Cassino, a Benedictine monastery situated on a mountain top, lying between Rome and Naples."

### Monastery frequently damaged

The havoc wrought early in 1944 to the Monastery of Monte Cassino was by no means the first it suffered. Only sixty years after Saint Benedictine founded the monastery on the site of an ancient temple of Apollo in 529 it was destroyed by Lombards in 589. It suffered again at the hands of the Saracens in 884, the Normans in 1030, and from an earthquake in 1349.

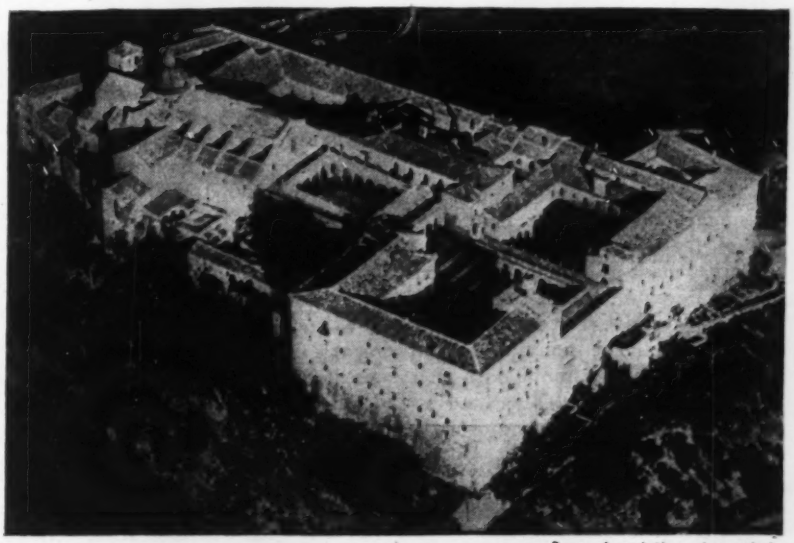
Through all these catastrophes the Frontinus manuscript was preserved. It was intact in 1897 and presumably was safe when the Germans occupied the monastery some weeks ago. It is reported that the art and literary treasures were removed by the Germans to a place of "safety." It is hoped that the manuscript will be restored to the monastery when it is once again rebuilt.

Frontinus deserves more than a passing notice. For years prior to the time the Emperor Nerva appointed him as Water Commissioner of Rome Frontinus held important offices of state. He had been praetor and three times a consul of Rome, as well as a governor of Britain. He had written treatises on strategems of war, surveying, boundaries and roads, and essays on farming. In his *De Aquis Urbis Romae* he said that before entering upon the duties of a new office he always familiarized himself with its nature and extent.

The reasons that impelled Frontinus to undertake a study of the water supply of Rome were stated by him as follows:

> Inasmuch as every office conferred by the emperor demands especial attention; and inasmuch as I am moved not only to devote diligence, but even love to any matter confided to my care, be it on account of inborn zeal, or by reason of faithfulness in office; and inasmuch as Nerva Augustus, an emperor of whom it is difficult to say whether he devotes more love or more diligence to the common weal, has now conferred upon me the duties of water commissioner (or waterworks superintendent, *curator aquarum*), duties contributing partly to the convenience, partly to the health, even to the safety of the city, and from olden time exercised by the most distinguished citizens; I therefore consider it to be the first and most important thing to be done, as has always been one of my fundamental principles in other affairs, to learn thoroughly what it is what I have undertaken.
>
> There is indeed no better foundation for any business; nor can it in any other way be determined what is to be done, and what omitted; nor is there for a fair-minded man so debasing a course as to perform the duties of an office intrusted to him according to the directions of assistants, a course, however, which must be followed, whenever an inexperienced official takes refuge in the practical knowledge of his assistants; whose services though necessary for rendering help should nevertheless be only a sort of hand and tool of the principal in charge. . . . It is for this reason that I have set down in this commentary all that I could gather as bearing on the subject matter, after having arranged and codified it in accordance with my habit as already exemplified in other offices, so that I might consult it as a guide in the duties of this.

The commentary, as Frontinus goes on to explain, includes the names and dates of additions to the supply, sizes and descriptions of the aqueducts, tanks and other storage facilities, the number of taps, consumption data, and the legal phases of water supply in Rome.



*Press Association, Inc. photo*

***Benedictine monastery atop Monte Cassino, Italy, in which was preserved the Frontinus manuscript on the water supply of Rome.***

# New Tax Law Authorizes Court Review Of Excess-Profit Findings

**John W. Gaskins and George R. Shields**
King and King, Attorneys, Washington, D. C.

CONGRESS has at last afforded to contractors an opportunity to test the reasonableness and fairness of administrative determinations of excessive profits under government contracts. By Title VII of the Revenue Act of 1943, the United States Tax Court, in Washington, D. C., has been given exclusive jurisdiction finally to determine the amount, if any, of such excessive profits. The determination of that court will not be subject to review by any other court or governmental agency.

Unfortunately, the relief thus extended will be available only to those contractors and subcontractors who have not concluded renegotiation agreements with the government fixing the amount of alleged excessive profits.

### Contractors must act quickly

Contractors eligible to file suit under authority of the act must, however, promptly exercise their right of suit or it will be lost. The act provides that suit must be filed in the United States Tax Court within 90 days (not counting Sundays or legal holidays in the District of Columbia) after the mailing of a notice of determination by the War Contract Price Adjustment Board, later mentioned. Or if a contractor or subcontractor feels aggrieved by a determination of one of the departments or agencies concerned made prior to the enactment of the Revenue Act of 1943, with respect to a fiscal year ending before July 1, 1943, the petition may be filed in the Tax Court within 90 days after the approval of the Revenue Act of 1943. The act was passed over the President's veto on Feb. 25.

By the Revenue Act of 1943, there is created a War Contract Price Adjustment Board consisting of six members. One member is to be appointed from each of the departments, administrations and agencies having authority to effect renegotiation of war contracts. The board will have the right to delegate the power of renegotiation to the secretary of any department concerned, who, in turn, may delegate such duty to any officer or agency of the United States that he may elect. When the officer or agency to whom the authority has been ultimately delegated has made a determination of excessive profits, the board is given discretion to review that determination. It may of its own volition review the matter within 60 days from the date of such determination, or, at the request of the subcontractor or contractor concerned, made within such 60-day period, it may review the decision. However, the question of whether there shall be a review by the board will be entirely within the discretion of the board, and the contractors affected do not have a right to insist upon such a review.

If the contractor does not ask for a review within 60 days, and the board itself does not undertake a review of the proceedings within that time, the decision of the subordinate officer or agency, previously referred to, fixing the amount of the alleged excessive profits, is from that date to be considered the determination of the board.

### The court remedy

At this point the Revenue Act of 1943 establishes the absolute right on the part of the contractor to have an impartial determination by the United States Tax Court, and the authority of the Tax Court in this respect is complete. Under the earlier renegotiation statutes no judicial review was provided. It has long been the law that administrative actions of executive officers vested with statutory discretion are not subject to review by the courts in the absence of error so gross or conduct so arbitrary or capricious as to raise the implication of bad faith. The burden of establishing such legal premise has rested entirely upon the person seeking relief. As the renegotiation act originally set forth no standards for determining excessive profits, as no record was made by the renegotiation authorities showing what transpired during the hearing, and as the contractor was never advised of the particulars forming the basis for a determination that excessive profits were realized, it was immediately apparent to Congress that any legislation designed to bring about simply a court review of administrative error would be futile and would place an impossible burden on the contractor to establish error.

### New proceedings required

Therefore, Congress determined that within 90 days after mailing of notice by the board a contractor or subcontractor might institute proceedings in the United States Tax Court for redetermination of the entire question of excessive profits. The act specifically states that the proceedings before the court shall not be treated as proceedings to review the determination by the board, but shall be treated as a proceeding *de novo*. Put differently, the entire controversy will be considered anew in all of its aspects.

Congress has determined that in the ascertainment of excessive profits consideration will be given to the following factors:

1. Efficiency of the contractor with particular regard to attainment of quantity and quality production, reduction of costs and economy in the use of material, facilities and manpower;

2. Reasonableness of cost and

profits with particular regard to volume production, normal pre-war earnings, and comparison of war and peacetime production;

3. Amount and source of public and private capital employed and net worth;

4. Extent of risk assumed, including the risk incident to reasonable pricing policies;

5. Nature and extent of contribution to the war effort, including inventive and development contributions and cooperation with the government and other contractors in supplying technical assistance;

6. Character of business, including complexity of manufacturing technique, character and extent of subcontracting and rate of turnover;

7. Such other considerations of which the public interest and fair and equitable dealing may require.

The true benefits from this new law will depend on how it is applied by the Tax Court.

# New Method to Determine Moisture Content in Sand

**C. R. Waters**

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The amount of water used in concrete batches must be accurately controlled in order to obtain uniform consistency in the resulting concrete. Uniformity is especially desirable in concrete pavement work, as wet and dry batches affect riding qualities.

While present-day equipment is efficient in the control of the added mixing water for concrete batches, there is one weak link in the chain of procedure. The amount of water contained in the sand, varying usually from 2 to 10 percent, must be known and taken into consideration. This percentage may vary considerably throughout the day's work.

The usual field practice is to obtain this moisture content by drying out a sample. This work takes time.

To improve on this procedure, studies have been made by District 5 of the New York State Department of Public Works and a new quick field method of determining the percentage of moisture in sand for concrete was developed. It is accurate, theoretically correct, and so simple and quick in results that an inexperienced person can test the sand in each batch, if necessary. The new method will appeal to the inspector and invite periodic testing.

The method is as follows:

(1) Obtain a metal container ($4 \times 4 \times 7.7$ in. approximately in size recommended) which will hold exactly 2 kg. of water, when struck off with a straight edge.

(2) Add 0.7± kg. of water.

(3) Add sand directly from the stock pile of a weight in kilograms equal to its specific gravity, for example if the specific gravity is 2.63, add 2,630 grams of sand.

(4) Fill container to overflowing with water.

(5) Strike off container with metal straight-edge.

(6) Weigh container and contents and, after determining weight of contents, consult the accompanying chart for the percentage of moisture in the sand.

In following the method outlined two precautions should be taken. These are: (1) The sand sample must be poured into the water; otherwise, air will be entrapped, and (2) If the container is painted, no water will adhere on outside after overflowing to cause errors.

The theory upon which the procedure is based is simple. The container holds two units of volume. If the sand is dry, one unit of sand of say 2.63 sp.gr. (2,630 grams) plus one unit of water (1,000 grams) equals a total of 3,630 grams.

If the sand contains moisture, say one percent, there is a decrease of 26.3 grams in sand weight, an increase of 10 grams in water weight, or a net decrease per 1 percent of moisture of 16.3 grams. Thus as the percentage of moisture in the sand increases, the total weight of the two units decreases uniformly.

**TABLE FOR OBTAINING MOISTURE CONTENT IN SAND**

| Percent of Moisture in Sand | Specific Gravity of Sand to be Tested | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2.59 | 2.60 | 2.61 | 2.62 | 2.63 | 2.64 | 2.65 | 2.66 | 2.67 | 2.68 |
| | Combined Weight in Grams of Sand and Water | | | | | | | | | |
| | 3590 | 3600 | 3610 | 3620 | 3630 | 3640 | 3650 | 3660 | 3670 | 3680 |
| ½ | 3582 | 3592 | 3602 | 3612 | 3622 | 3632 | 3642 | 3652 | 3662 | 3672 |
| 1 | 3574 | 3584 | 3594 | 3604 | 3614 | 3624 | 3633 | 3643 | 3653 | 3663 |
| 1½ | 3566 | 3576 | 3586 | 3596 | 3605 | 3615 | 3625 | 3635 | 3645 | 3655 |
| 2 | 3558 | 3568 | 3578 | 3588 | 3597 | 3607 | 3617 | 3627 | 3637 | 3646 |
| 2½ | 3550 | 3560 | 3570 | 3580 | 3589 | 3599 | 3609 | 3618 | 3628 | 3638 |
| 3 | 3542 | 3552 | 3562 | 3571 | 3581 | 3591 | 3600 | 3610 | 3620 | 3630 |
| 3½ | 3534 | 3544 | 3554 | 3563 | 3573 | 3583 | 3592 | 3602 | 3612 | 3621 |
| 4 | 3526 | 3536 | 3546 | 3555 | 3565 | 3574 | 3584 | 3594 | 3603 | 3613 |
| 4½ | 3518 | 3528 | 3538 | 3547 | 3557 | 3566 | 3576 | 3585 | 3595 | 3604 |
| 5 | 3510 | 3520 | 3529 | 3539 | 3548 | 3558 | 3567 | 3577 | 3586 | 3596 |
| 5½ | 3503 | 3512 | 3521 | 3531 | 3540 | 3550 | 3559 | 3569 | 3578 | 3588 |
| 6 | 3495 | 3504 | 3513 | 3523 | 3532 | 3542 | 3551 | 3560 | 3570 | 3579 |
| 6½ | 3487 | 3496 | 3505 | 3515 | 3524 | 3533 | 3543 | 3552 | 3561 | 3571 |
| 7 | 3479 | 3488 | 3497 | 3507 | 3516 | 3525 | 3534 | 3544 | 3553 | 3562 |
| 7½ | 3471 | 3480 | 3489 | 3499 | 3508 | 3517 | 3526 | 3535 | 3545 | 3554 |
| 8 | 3463 | 3472 | 3481 | 3490 | 3500 | 3509 | 3518 | 3527 | 3536 | 3546 |
| 8½ | 3455 | 3464 | 3473 | 3482 | 3491 | 3501 | 3510 | 3519 | 3528 | 3537 |
| 9 | 3447 | 3456 | 3465 | 3474 | 3483 | 3492 | 3501 | 3511 | 3520 | 3529 |
| 9½ | 3439 | 3448 | 3457 | 3466 | 3475 | 3484 | 3493 | 3502 | 3511 | 3520 |
| 10 | 3431 | 3440 | 3449 | 3458 | 3467 | 3476 | 3485 | 3494 | 3503 | 3512 |

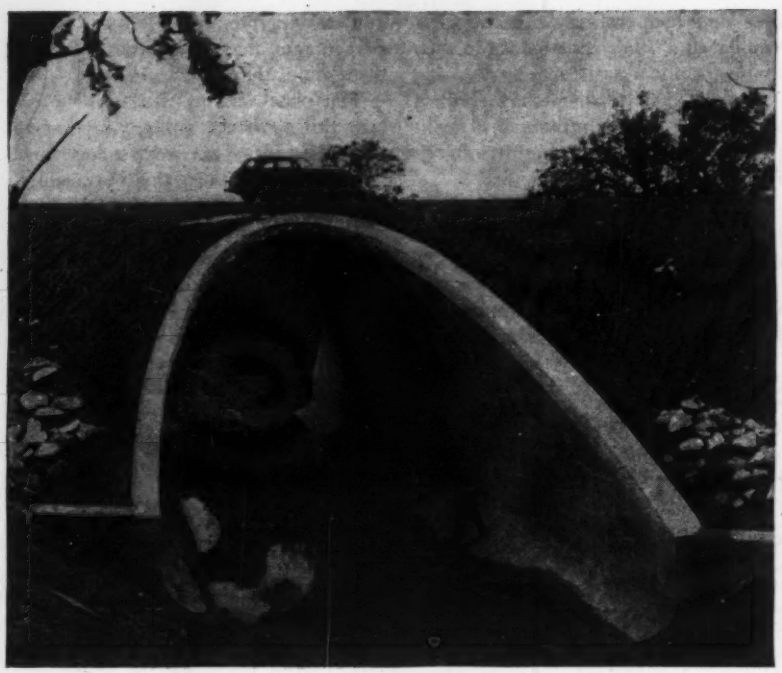


**Fig. 1. Concrete quantities in Kansas culverts are speedily and accurately calculated by a semi-graphical method.**

# Concrete Arch Quantities By Graphics

**T. W. Oliver**
Associate Bridge Engineer, Kansas State Highway Commission, Topeka, Kan.

***Contents in Brief**—Computing the volume of concrete in sloping wings of arch culverts under Kansas highways is simplified by a combined graphical and analytical method. Vertical sections are cut through the wings at frequent intervals. These projected areas are "planimetered" and the volume of concrete computed by the average-end-area method. Large-scale drawings speed up the work and give satisfactory results.*

FOR THE PAST SEVERAL YEARS the Kansas Highway Commission has been calculating the volume of concrete in its arch culverts by a practical and satisfactory semi-graphical procedure. Although not claimed to be original in its inception, the procedure herein outlined illustrates a simple yet expeditious method of accurately calculating the volume of concrete in the sloping end-sections, or wings, of arch culverts.

The shape of these sloping wings, together with the superimposed concrete collars, or wing-parapets, are such as to make strict mathematical calculation of their volumes impractical. Consequently, the end-area method is employed with areas being obtained by planimetering cross-sections cut through the wing perpendicular to the barrel axis (see sections 4, 18 and 26 of Fig. 3.)

### Large-scale drawings

An accurately drawn, fairly large-scale and elevation of the culvert barrel and collar is needed, and a scale drawing of $\frac{1}{2}$ in. equals 1 ft. usually will be satisfactory. Cross sections are projected upon this elevation at 1-ft. intervals near the high end and at not more than 4-ft. intervals along the wing slope. The following step-by-step graphical operations are required to project the necessary end-areas, ready for measuring with a planimeter: (All references are to Fig. 3).

1. Draw a half-section of the arch barrel (a) from the plan dimensions of the culvert and strike off 1-ft. intervals along the vertical axis from 0 to 13.67. The top lines of the collar, 0-13.67 and 0-13 are projected later.

2. Sketch the side elevation of the sloping wing (b) except for line 0.75-27.33 (intersection of back face of collar and barrel extrados). The solid line 0-27.33 represents the top face of wing collar and base line for collar projection. The dotted line 0-26 is the intersection between the inside face of collar and barrel intrados. Both of these lines are on the 1 on 2 slope of the culvert wing, and the dotted line 0-26 is the distance *d* vertically below line 0-27.33.

3. Lay out a half-plan of the culvert wing as shown in (c), except for the wing collar.

4. Project the inside collar line, shown in (c) by intersection of verticals erected from points chosen in (b) and the projections of corresponding points from (a) which are rotated through the 45-deg. line on to the plan view of the culvert wing.

5. Construct the inside top line, 0-13, of collar in (a) by intersection of horizontal lines drawn from points selected on (b) and verticals erected from corresponding points along the barrel intrados. The inside face of the collar is vertical so points on both the top and bottom inside lines of the collar will fall on line 0-26 as shown in (c).

6. Plot the outside line 0-27.33 of the collar shown in (c) by using a compass set to a radius of dimension C and striking a series of arcs with the pivotal point of the compass placed at points along line 0-26. Short tangents to these arcs will form the desired outside line of the collar.

7. Construct the outside top line of the collar in (a), designated 0.75-13.67, by the intersection of horizon-

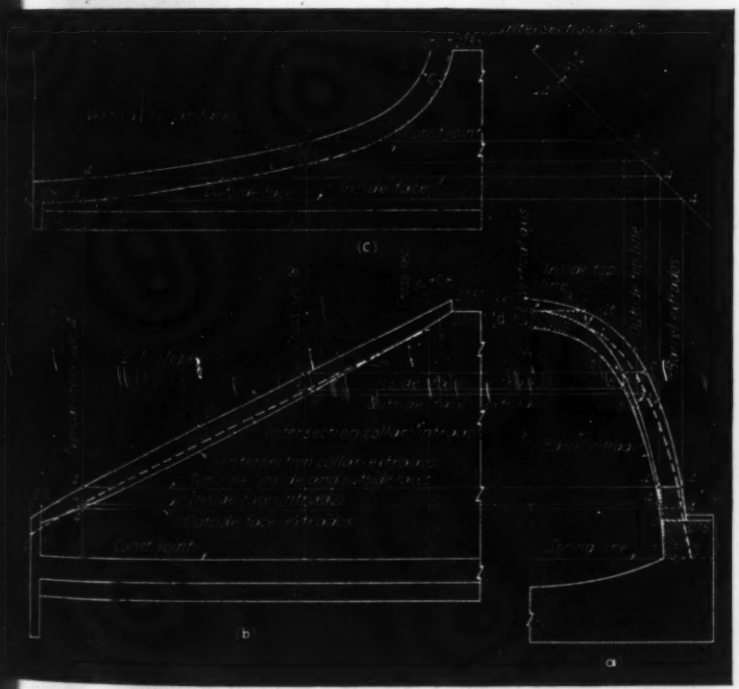
lines drawn from points selected (b) and projections of correspond- points in (c), deflected through 45-deg. line.

3. From points along the outside top line, 0.75-13.67, of the wing collar in (a), drop verticals to intersect the barrel extrados, shown as a dotted line. From these points project horizontal lines to intersect corresponding verticals in (b). Through these intersections, draw the intersection line of the barrel extrados and the outside face of the collar in (b).

Typical cross sections through the sloping wing and collar at points 4, 18 and 26 are shown projected on to the half-end elevation in Fig. 2a. The area to be measured at each of these points, indicated by dotted shading, is bounded by the rectangle cut through the collar and the intrados and extrados lines of the barrel, extending in each case down to the springing line at S-S.

As a check on the accuracy of the large-scale drawings and the planimetered areas, the cross-sectional area of a section through the barrel should be computed for comparison with the area obtained by measuring it with a planimeter.

*2. Type of non-reinforced concrete arch culvert used under Kansas highways.*



*3. Vertical sections are struck through the sloping culvert wings and projected an end elevation (a) for measurement by a planimeter in calculating the me of concrete. Large-scale drawings of the side elevation (b) and plan (c) of the wing simplify the mechanical construction and insure the accuracy calculations.*

## Army Engineers Report Much Building in South

Military construction totalling almost a billion dollars was supervised by the Army Engineer Corps' Mobile district office during the past three years. An itemized report, released recently, showed actual outlay of $860,000,000 for major installations, and Lt. Col. W. P. DeJarnette, executive assistant for the Mobile office, estimated the cost of all Army-supervised construction in the district during the three-year period as one billion.

The district comprises Alabama, Mississippi, West Tennessee, Northwest Florida and a section of Georgia adjoining Alabama. Col. Herbert I. Collins is present Mobile District engineer, and the office is under Brig. Gen. J. S. Bragdon, engineer for the South Atlantic Division.

The billion-dollar figure does not include cost of Navy installations or any other war construction not supervised by the district office, such as shipbuilding or expansion of the steel plants.

The costliest installation was the Alabama Ordnance Works at Childersburg, totalling $77,000,000. The munitions plant, was designed and is operated by E. I. DuPont de Nemours & Co. An adjunct, the Coosa River Ordnance Works, at Talladega, was constructed for $14,000,000.

As in other parts of the country, this construction program in the South is rapidly nearing completion.

# Adjusting Traverses on Plane Grid System

**Russell I. Boyce**
Civil Engineer and Land Surveyor, Hartford, Conn.

***Contents in Brief—A new method of adjusting precise traverses is made available and its use illustrated step by step for a typical problem. Method's greater accuracy as compared to normal procedure also is demonstrated.***

MUCH GREATER ACCURACY in the adjustment of precise traverses that run between lines giving position and azimuth control on a plane grid is possible by following a modification of the usual method. Known as the "length factor-progression method of adjustment," the modified procedure requires little, if any, extra work.

The new procedure can best be described by first outlining the usual method, which is described in detail on pp. 49 and 59 of *Manual of Plane-Coordinate Computation*, Special Publication No. 193 of the Coast and Geodetic Survey. The method consists of the following five steps:

1. Angle adjustment for azimuth closure: In this step, the angular discrepancy between the control azimuth of the closing line and the azimuth of the same line as obtained by the field survey, is distributed equally to each field angle of the traverse.

2. Course length adjustment: Several corrections are applied to the length of each course as measured in the field to obtain the grid length. The geodetic length is first obtained by applying the corrections for tape calibration, temperature differences, incline to the horizontal, and reduction to sea level. Next, the geodetic length of each course is reduced to the approximate grid length by computing and applying the approximate scale factor for that course.

3. Computation of departures and latitudes: Using as arguments the approximate grid lengths of Step 2 and the sines and cosines of the azimuths of Step 1 the initial $dx$'s (departures) and $dy$'s (latitudes) are computed for the courses.

4. Correction of the scale factor: From the $dx$'s or $dy$'s of Step 3 the approximate $X$ or $Y$ coordinate, whichever is required, is computed for each traverse station. From these coordinates new scale factors, to replace those of Step 2, are determined and applied to the geodetic lengths of Step 2. New $dx$'s and $dy$'s for the courses are then computed, using as arguments these new grid lengths and the sines and cosines of Step 3. Ordinarily this correction is necessary for only first-order traverses.

5. Final adjustment: The algebraic summation of the $dx$'s is made and compared with the difference $DX$ between the $X$ coordinates of the two control stations. The discrepancy is apportioned to the several $dx$'s according to the ratio $\left(\frac{L}{\text{Sigma } L}\right)$ in which $L$ equals the course length and Sigma $L$ the sum of all the lengths. In a similar manner the discrepancy between $DY$ and the $dy$ summation is determined and adjusted out. With these adjustments applied we have the final values for the $dx$'s and $dy$'s of the several traverse courses. From these final values the course lengths, azimuths, and coordinates of the adjusted traverse are computed.

#### Method results in discrepancies

It is to be noted that when the $dx$ and $dy$ of a course are changed the azimuth of the course is altered, unless the change is proportional to the ratio of $dx$ to $dy$. This azimuth change, assuming that the traverse station angles remain fixed, will change the azimuth and $dx$ and $dy$ of every other course. The usual method of adjustment does not take this fact into account. As a result, all too frequently, larger discrepancies than are justified occur between the values of the traverse angles as measured in the field and their adjusted values.

To overcome the weaknesses in the usual method, the writer developed the "length factor-progressi method. This method breaks the f adjustment down into two parts considers the error of closure to sist of: (1) Errors in the meas ments of the course lengths and errors in the measurements of the tion angles. These two types of er are considered in turn and adjus out. In this adjustment, Step 5 of usual method is changed, but previous steps remain unchanged.

In the method here described analysis is made of the error closure diagram for the traverse. analysis may be either mathemati or graphical. The graphical anal is faster, therefore more practi and should be used in practice.

The assumed traverse runn from Control Station $A$ to Con Station $B$ in Fig. 1 will be used t lustrate the method of adjustment

#### Use of computation sheet

All computations necessary to just the assumed traverse of Fig are listed in the accompanying ta Construction of the table will now described, step by step. First, in umn 1 each traverse station is li in the order of its occurrence in traverse, also the azimuth of course. Below the azimuth of course is placed the course bear as determined from the azimuth.

In Column 2 is listed the length of each course. Immedi above and below each grid lengt placed the natural sine and co respectively, of the course bearin it is desired to compute the co $dx$'s and $dy$'s on a calculating chine. The writer has omitted step for this traverse and has c puted the initial $dx$'s and $dy$' logarithms, as shown in Colum However, in actual practice methods of computing the initial and $dy$'s should be used, one check against the other. The value these $dx$'s and $dy$'s are listed in umns 4 and 5 and their algeb summations obtained.

In Column 8 opposite the starting and closing control stations are placed the $X$ and $Y$ coordinates of these two stations. At the bottom of Column 8 the difference $DX$ between the $X$ coordinates of the two control stations is determined, as is the difference $DY$. The values of $DX$ and of $DY$ are now listed under the $dx$ and $dy$ summations at the bottom of Columns 4 and 5, respectively, and the discrepancies between values determined. These discrepancies are used to construct Fig. 2 for the traverse. Elimination of the discrepancies make up the adjustment of the traverse.

Triangle $BCK$ of Fig. 2 is the "error of closure" diagram for the assumed traverse. Point $B$ represents the correct or control position of traverse Station $B$ of the assumed traverse. Point $K$ represents the position of the same station as determined by the traverse as run from Station $A$.

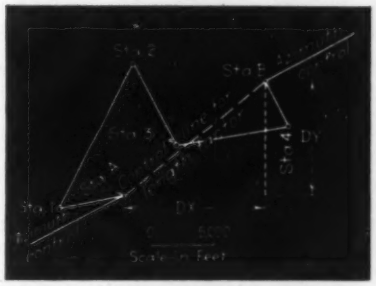


***Fig. 1. Assumed traverse running from Control Sta. A to Control Sta. B used to illustrate new adjustment method.***

Through $K$ a line is drawn having the same direction as the straight line between Points $A$ and $B$ of the traverse. From $B$ in Fig. 2 a perpendicular is drawn to this line passing through $K$, the perpendicular intersecting the line at Point $F$.

Line $FK$ represents the total linear error in the traverse, while Line $FB$ represents the total error in the traverse due to errors in measuring the angles. Justification for this assumption is easily established, since the sum of the projections of the several courses on Line $AB$ of Fig. 1 must equal the length $AB$, which equals $AF$ very closely. Hence, the discrepancy $FK$ is a measure of the linear error. The remaining error, $FB$, is considered angular in origin.

In the traverse adjustment either the linear error $FK$ or the angular error $FB$ may be eliminated first. Here the linear error is considered first. This error is adjusted out by applying a length factor, L.F., to the traverse distances. This factor is determined by solving either the formula L.F. equals $DX$ divided by [$DX$ plus $JK$] or L.F. equals $DY$ divided by [$DY$ plus $JF$]. The values of $JK$ or $JF$ are measured by scale on Fig. 2. The values are given a plus or minus sign,

**CONTROL TRAVERSE COMPUTATIONS FOR LENGTH FACTOR-PROGRESSION ADJUSTMENT**

| Col. 1<br>Station<br>Azimuth<br>Bearing<br>$N$ | Col. 2<br>Sine bearing<br>Course length<br>Cosine bearing | Col. 3<br>Log $dx$<br>Log. sin. bear.<br>Log. length<br>Log. cos. bear.<br>Log. $dy$ | Col. 4<br>Initial $dx$<br>Corr'n.<br>Final $dx$ | Col. 5<br>Initial $dy$<br>Corr'n.<br>Final $dy$ | Col. 6<br>V times length<br>$NL_x$ | <br><br>$NL_y$ | Col. 7<br>Corrections in ft.<br>Length factor progression<br>Total<br>$dx$ | <br><br><br>$dy$ | Col. 8<br>Coordinate computation in ft.<br>Final $dx$<br>$X$ Coordinate | <br>Final $dy$<br>$Y$ Coordinate | Col. 9<br>Tan. final bearing ($dx \div dy$)<br>Final bearing<br>Final azimuth<br>Final course length |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sta. $A$ | | 3.7182716 | | | | | | | | | |
| | | 9.9921932 | | | | | | | 750,000.00 | 750,000.00 | 5,226.53 ÷ 1,000.12 |
| 9-10-07.2 | 5,322.04 | 3.7260784 | −5,227.23 | −1,000.11 | | | +0.44 | +0.09 | −5,226.53 | −1,000.12 | 79-10-01.7 |
| 9-10-07.2 | | 9.2739693 | +0.70 | −0.01 | +5,300 | −5,300 | +0.26 | −0.10 | | | 79-10-01.7 |
| $N=1$ | | 3.0000477 | −5,226.53 | −1,000.12 | | | +0.70 | −0.01 | | | 5,321.36 |
| Sta. 1 | | 3.7777733 | | | | | | | 744,773.47 | 748,999.88 | |
| 7-31-57.3 | 12,968.60 | 9.6648799 | | | | | −0.51 | −0.97 | +5,993.00 | +11,499.42 | |
| 7-31-57.3 | | 4.1128934 | +5,994.78 | +11,499.89 | | | −1.27 | +0.50 | | | |
| | | 9.9478003 | −1.78 | −0.47 | −25,900 | +25,900 | | | | | |
| $N=2$ | | 4.0606937 | +5,993.00 | +11,499.42 | | | −1.78 | −0.47 | | | |
| Sta. 2 | | 3.5434198 | | | | | | | 750,766.47 | 760,499.30 | |
| 3-44-07.2 | 7,380.03 | 9.6753614 | | | | | −0.30 | +0.55 | +3,495.57 | −6,499.13 | |
| 9-15-52.8 | | 3.8680514 | +3,494.78 | −6,500.11 | +22,100 | +22,100 | +1.09 | +0.43 | | | |
| | | 9.9448623 | +0.79 | +0.98 | | | | | | | |
| $N=3$ | | 3.8129207 | +3,495.57 | −6,499.13 | | | +0.79 | +0.98 | | | |
| Sta. 3 | | 3.9539910 | | | | | | | 754,262.04 | 754,000.17 | |
| 9-31-58.7 | 9,118.99 | 9.9940444 | | | | | −0.76 | −0.13 | +8,993.14 | +1,500.11 | |
| 9-31-58.7 | | 3.9599466 | +8,994.79 | +1,499.89 | | | −0.89 | +0.35 | | | |
| | | 9.2161128 | −1.65 | +0.22 | −18,200 | +18,200 | | | | | |
| $N=2$ | | 3.1760594 | +8,993.14 | +1,500.11 | | | −1.65 | +0.22 | | | |
| Sta. 4 | | 3.3021600 | | | | | | | 763,255.18 | 755,500.28 | |
| 9-11-24.3 | 4,033.62 | 9.6964649 | | | | | | | −2,005.24 | +3,499.67 | |
| 9-49-35.7 | | 3.6056951 | −2,005.21 | +3,499.89 | −4,000 | +4,000 | +0.17 | −0.30 | | | |
| | | 9.9383593 | −0.03 | −0.22 | | | −0.20 | +0.08 | | | |
| $N=1$ | | 3.5440544 | −2,005.24 | +3,499.67 | | | −0.03 | −0.22 | | | |
| Sta. $B$ | | | +11,251.91 | +8,999.45 | −20,700 | +64,900 | | | 761,249.94 | 758,999.95 | |
| | | | −11,249.94 | −8,999.95 | | | −0.96 | −0.76 | 750,000.00 | 750,000.00 | |
| | | | | | | | −1.01 | +1.26 | | | |
| | | | +1.97 | −0.50 | | | −1.97 | +0.50 | +11,249.94 = $DX$ | +8,999.95 = $DY$ | |

Note: Progression correction = $K(NL)$; $K_x$ = Angle error in $DX$ ÷ Sigma $NL_x$ = −1.01 ÷ −20,700 = 0.000049 ft. per ft. and $K_y$ = Angle error in $DY$ ÷ Sigma $NL_y$ = 1.26 ÷ 64,900 = 0.019 ft. per ft. Length Factor Correction = Course difference $x$ ([$DX$ ÷ ($DX$ + Length Error in $DX$)] − Unity) = (11,249.94 ÷ 11,250.90) − 1 = −0.000085

depending upon whether the traverse lengths must be decreased or increased.

In the traverse being studied, the lengths must be decreased in order to bring the adjusted location to *F* in Fig. 2 and therefore the L.F. must be less than unity; hence the signs will be plus. For the traverse of Fig. 1 the L.F. equals

$$\frac{11{,}249.94}{11{,}249.94 + 0.96} = 0.999915$$

The length factor correction is the length factor minus unity, which equals

$$(0.999915) - (1.000000) = -0.000085$$

After this correction is found, the initial *dx*'s and *dy*'s of Columns 4 and 5 are multiplied, on the slide rule if desired, by this correction and the products listed in Column 7. For Course *A*-1 these corrections are, respectively

$$(-\ 0.000085)\ (-\ 5{,}227) = +\ 0.44' \text{ and}$$
$$(-\ 0.000085)\ (-\ 1{,}000) = +\ 0.09'$$

The algebraic sums of all such corrections are placed at the bottom of Column 7. The sums must equal *JK* and *JF*, respectively, of Fig. 2.

With these corrections computed the remaining angular error of closure is represented by the triangle *BHF* of Fig. 2. It is made up of the error *FH* in the *X* direction and *HB* in the *Y* direction. The value of *HF* is of course equal to the algebraic difference between the original error *CK* in the *X* direction and the linear error *JK*, while *BH* is equal to the corresponding difference in the *Y* direction. These two errors are adjusted out by arithmetical progressions, the theory being that each station angle will thus be changed an equal amount. This theory is not exactly true, because all the traverse angles seldom equal closely 180 deg. However, this error in theory does not invalidate the method. In fact, this error may be eliminated, if desired, by introducing the rates of change of the sines and cosines of the traverse course azimuths as factors in evaluating the constant *K* as determined in the next paragraph.

The progression correction equals *KNL* for any course; *K* being the progression constant, *N* the number of angle changes which have made up the total correction to the azimuth of the course, and *L* the course length. The number of angle changes, *N*, is

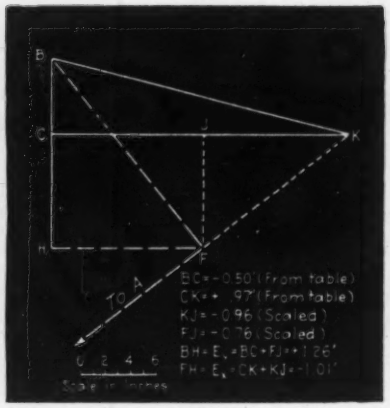



***Fig. 2. Error of closure diagram for assumed traverse of Fig. 1.***

tabulated in Column 1 and increases from unity at each end course up to a maximum value at the middle course or courses of the traverse. The total progression correction equals the sum of the course corrections, therefore, *K* may be found by solving the equation $E = K$ (Sigma *NL*), where *E* is the total error to be adjusted out. Two *K* constants must be determined, $K_x$ being the progression constant to eliminate the error *HF* in the *X* direction and $K_y$ the constant to eliminate the error *HB* in the *Y* direction.

In Column 6 are listed *N* times the course length or $NL_x$ and $NL_y$. The only difference between these two values for each course is a possible difference in sign. The sign, plus or minus, for the $NL_x$ and $NL_y$ of a course is determined by noting on Triangle *BHF* of Fig. 2 whether the course azimuths must be increased or decreased to eliminate the error *BF*. If the azimuth of the straight line *AF* has to be increased to make *F* coincide with *B*, then the individual course azimuths must be increased, and vice versa. After noting whether the azimuths must be increased or decreased it must be observed in which direction, plus or minus, the azimuth correction changes the *dx* and *dy* of each course.

For the traverse of Fig. 1, the required azimuth change is minus, since the azimuths are measured clockwise from zero degrees to the south around through 180 deg. to the north back to 360 deg. to the south. This being the case, a course with its azimuth in the first quadrant, that is between 0 and 90 deg., will take a plus *dx* correction and a minus *dy* correction and the sign for $NL_x$ will be plus while the sign for $NL_y$ will be minus. With the azimuth in the second quadrant the signs will both be minus; in the third minus and plus, respectively; and in the fourth both plus.

The algebraic summations of the values of $NL_x$ and $NL_y$ are now made and tabulated at the bottom of Column 6. For this traverse the $NL_x$ summation equals minus 20,700 and the $NL_y$ summation plus 64,900. From Fig 2, *FH* equals minus 1.01 ft. and *HB* equals plus 1.26 ft. The value of $K_x$ therefore equals

$$\frac{-\ 1.01}{-\ 20{,}700} = +\ 0.000049 \text{ ft. per ft.}$$

while $K_y$ equals

$$\frac{1.26}{64{,}900} = 0.000019 \text{ ft. per ft.}$$

The progression corrections are listed in Column 7 under the length factor corrections. They are determined by multiplying, on the slide rule if desired, the $NL_x$ and $NL_y$ of each course by $K_x$ and $K_y$, respectively. The algebraic summations of these corrections are made and they must equal *FH* and *HB*, respectively, of Fig. 2.

Now available in Column 7 are two corrections for the *dx* and two for the *dy* of each course. The algebraic sum of these two corrections is made to determine the total correction to be applied to the *dx* and *dy* of the course. Thus, the total correction to be applied to the *dx* of course *A*-1 is +0.70 ft. while the total *dy* correction is —0.01 ft. These corrections are tabulated in Columns 4 and 5, respectively, and applied to the initial *dx*'s and *dy*'s to obtain the final adjusted values of the *dx*'s and *dy*'s. These adjusted values are transferred to Column 8 and the *X* and *Y* coordinates of the several traverse stations are then computed. In Column 9 is tabulated the azimuths and course lengths of the adjusted traverse.

The length factor-progression method of adjustment may be applied to a loop traverse by considering the loop made up of two traverses, or the two parts extending from the starting station to the middle station of the loop. The accepted or control location of this middle station will be its initial position, as found by the traverse, corrected by one half of the total error of closure of the loop. The two parts of the loop will then be adjusted, independently, by the length factor-progression method.

A graphic comparison of the angu- discrepancies between the field d final values of the angles of five verses when adjusted by the usual thod and the author's method is own in Fig. 3. Traverse No. 1 is a st-order traverse whose adjustment the usual method is given in Spe- l Publication No. 193 previously entioned. The remaining four are of cond-order accuracy and their ad- stments by the usual procedure are own in *Manual of Traverse Com- tation on the Lambert Grid*, Special ublication No. 194 of the Coast and odetic Survey.

In the five traverses are 82 angles. he maximum discrepancy by the ngth factor-progression method is 5 sec., which occurs in Traverse 4, while the maximum by the usual method is 11.7 sec., also in Traverse 4. In Traverse No. 1 the maximum discrepancy by the author's method was 2.0 sec., which is exceeded seven times by the usual method. In Traverse 2 the maximum error of 3.9 sec. by the author's method is exceeded twice. In Traverse 3 the same maximum of 3.7 sec. is exceeded twice, in No. 4 eight times and in No. 5 the length factor-progression maximum of 4.3 sec. is exceeded twice. In addition, the discrepancies for 14 angles are greater as adjusted by the usual method than the 4.5 sec. maximum of the author's. It is believed that had the rates of change of the sines and cosines of the traverse course azimuths been used, as suggested above, in evaluating $K$ these angular discrepancies by the new method would be further reduced. Based upon these comparisons and other studies the writer considers the new method justifies itself.

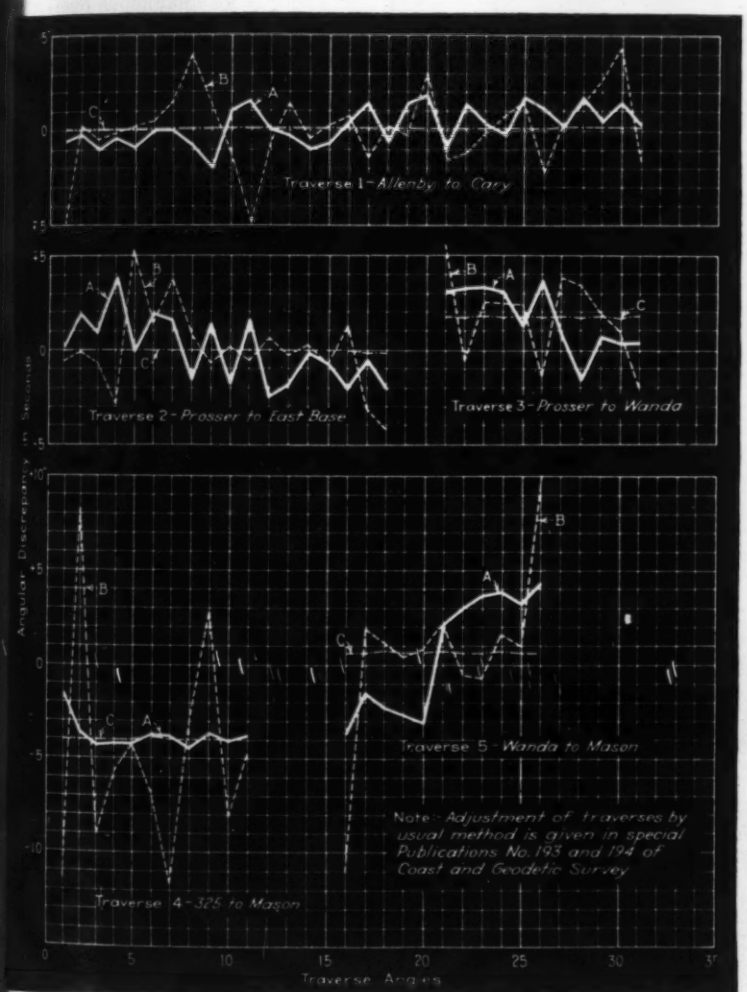

Traverse 1 - Allenby to Cary
Traverse 2 - Prosser to East Base
Traverse 3 - Prosser to Wanda
Traverse 5 - Wanda to Mason
Note - Adjustment of traverses by usual method is given in special Publications No. 193 and 194 of Coast and Geodetic Survey
Traverse 4 - 325 to Mason
Angular Discrepancy in Seconds
Traverse Angles

**Fig. 3. Discrepancies between final and field values of the angles of five traverses. Curves marked A show results when author's method of adjustment was used, B curves adjustment by usual method, and C curves (from Step 1 of adjustment procedure) correction for azimuth closure.**

## Work Pushed on Gaps In Pan American Highway

With the completion of road construction in parts of Colombia and Ecuador, there will be available for continuous motor travel some 10,000 miles of the Pan American Highway system.

When roadbuilding now in progress in these two countries is finished, motorists will be able for the first time to drive all the way from the Gulf of Darien in northeastern Colombia to Buenos Aires along the Pan American Highway route. Actually the entire length of South America will be available for continuous motor travel. Highways already are open south of Buenos Aires to Strait of Magellan.

The major gaps remaining in the Pan American route from northern Colombia to Buenos Aires are in Ecuador. Road construction has been undertaken there with the aid of $2,300,000 in credits from the U. S. Export-Import Bank.

In Colombia, a 76-mi. connecting road remains to be finished between Turbo and Pavarandicito, northern terminus of the Pan American Highway in South America, before motorists can reach the highway from the Gulf of Darien on the border of Panama. Access to the Pan American Highway is expected to be over this connecting road for some years because the projected route through the unexplored jungle of Southern Panama remains to be surveyed.

The three unconstructed sections in Ecuador total about 235 mi. The remaining 437 miles of the projected 672-mi. route are finished. The first gap is between Guamote and Tambo, a section 79 mi. in length. The second gap is between Cumbe and Saragurao, a section 75 mi. long.

A final 79-mi. gap is between Las Chinchas and Macara, a mountainous area on the Peruvian border.

From the Peruvian-Ecuadoran border the Pan American Highway, is open to continuous motor travel, without detours or ferrying, through Peru and Chile to Buenos Aires.

# Postwar Sewage Disposal Prospects in Canada

***Editor's Note**—The following extracts from an address by A. E. Berry, director of the sanitary engineering division, Ontario department of health, before the New York State Sewage Works Association, outline sewerage developments and prospects of our northern neighbor. According to Dr. Berry much work is planned for the postwar period, the design and construction of which will reflect practice in the United States.*

TODAY there is the gratifying prospect of major developments that will lead to the widespread provision of sewage disposal facilities in Canada. Abatement of stream pollution is on the essential list, and the construction of a substantial number of treatment plants is anticipated immediately following the war.

Canadian practice has responded to both external and internal influences. In earlier days English methods were reflected in our municipalities, but in recent years there has been a more pronounced linking with American procedure, and especially since mechanization has been applied. In addition to these influences from abroad our conditions have called for measures of local significance.

It may not be easy to visualize the extent of Canada, and the anomalous factors which have a bearing on sewerage practice. The population of twelve millions is dispersed over a wide territory, and much of this is listed as rural. This rural percentage, however, is steadily decreasing, as greater concentration takes place in the cities. Industrial developments associated with the war have suddenly augmented urban populations, and it is anticipated that much of this will continue in the postwar era, a period in which industry is expected to operate at a considerably expanded rate over that of prewar days. Canada is planning now, and is indoctrinated with the concept that an industrial expansion will be needed to supply the demands of a higher standard of living for citizens in the future.

### Sewerage and treatment

In the design and construction of sewers the procedure in Canada is similar to that in the United States. Our rainfall rates are quite variable across the Dominion, with the high annual precipitation at the coasts, and the low figures inland. Intensity records are available for representative stations, and some use, although probably not as much as might be expected, is made of these. Some solution has been sought to standardize on the minimum size of sewers. This is 8 in., 9 in. or 10 in. according to the preference of the designer.

There is no unanimous opinion in Canadian municipalities in respect to the use of separate or combined sewers. In general, where convenient stormwater outlets are available separate sewers are used. The requirement for treatment plants has not induced widespread use of separate sewers, although there appears to be an increasing interest in separate rather than combined systems. A difficulty with this has been the problem of preventing heavy infiltration in time of rain. This has been sufficiently great in some instances to nullify to a considerable extent the advantages of the separate sewer system.

In sewage treatment, Canadian practice is not unlike that generally followed in northern United States. The composition of our sewage is

Dorr Co. photo

***Fig. 2. At Regina, Saskatchewan, outmoded sedimentation basins were recently replaced with this combination flocculator and clarifier installation to secure greater removal of suspended solids and reduction in biochemical oxygen demand.***

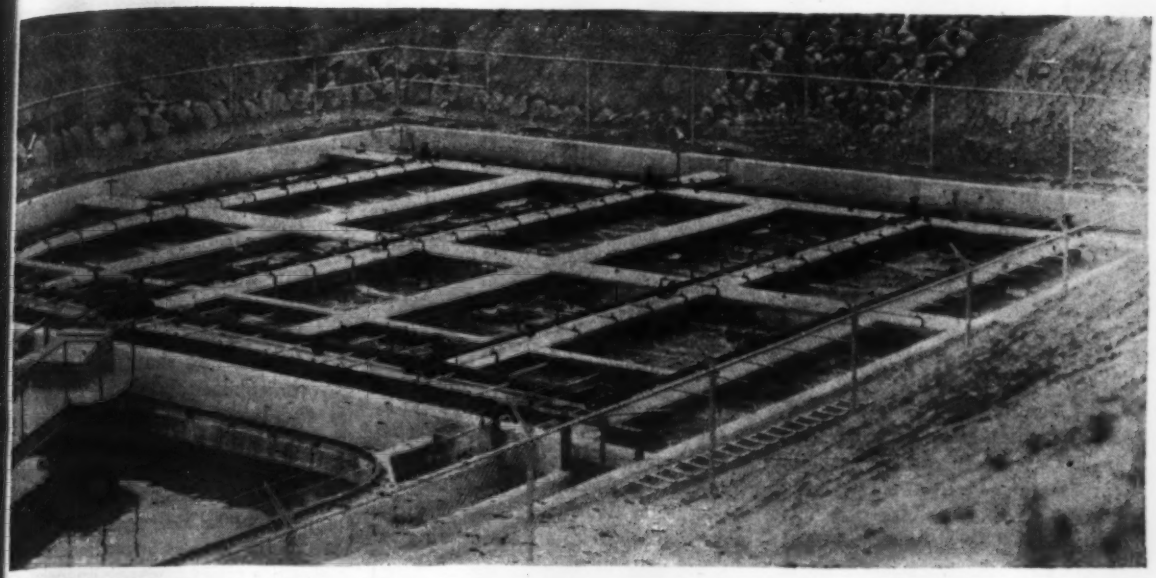


*Fig. 2. Aeration tanks at the Brampton, Ontario, sewage treatment works. This municipality was the first to use activated sludge in Canada, the initial installation having been made in 1918.*

much like that in this country, with large per capita water consumption. Mechanization of plants is increasing markedly, and since this equipment is made either in the United States or in Canada, its design is influenced chiefly by that in this country.

In any place the size of Canada there must be a wide variation in the volume and use made of the waters which receive sewage discharges. In Ontario, at least, there fortunately are available many lakes and large rivers which provide substantial dilution for sewage. This would be most useful except that drinking water supplies usually must be taken from the same source. The Great Lakes system of fresh water has provided a convenient receptacle for sewage and other wastes, but there is a growing recognition of the necessity for conserving the purity of these waters both to safeguard drinking supplies, and to retain them for the general benefit of the public. Consequently it is essential that adequate treatment of sewage be provided to meet these conditions. It is anticipated that the postwar era will present a major opportunity for progress in this direction.

Trade wastes in Canadian municipalities generally have not created the same problems as are found in many American cities. In recent years, however, a change in this is noted. Our practice of not requiring primary treatment at the industry site may have to be modified to protect sewers and to assist the treatment plant. There is generally a reluctance on the part of municipalities to impose undue restrictions on industries, and the taxpayers are asked to shoulder the extra expense for treatment.

### Developments in treatment

At present there are about 500 sewer systems in use in Canadian municipalities, some of which serve but limited areas in those communities. This number is in contrast to the total of 1,300 waterworks systems in public use. In spite of the fact that the progress experienced in the past would be regarded as substantial there is a great deal yet to be done in this field.

In sewage treatment the picture is even less attractive—only 115 municipalities have treatment works in operation, and 71 of these are in province of Ontario, this in spite of the fact that so many of the large receiving waters are in this province. In this total number of plants 52 are primary and 63 are for secondary or complete treatment. Activated sludge is used in 30 secondary treatment works in Ontario. For a number of years the activated sludge process has been employed wherever complete treatment was indicated. Local conditions have favored this process.

It is not out of place perhaps to dwell for a moment on the processes which have led up to the present status in treatment in Canada. There is in this development an evidence of the swings back and forth in processes and procedures—some to be abandoned entirely, others to be revived later in a somewhat modified form.

The early disposal plants were chiefly sedimentation units, first those employing plain, single-story tanks, later the two-story Imhoff type. Both of these have felt the effects of obsolescence, except for small units or where local conditions make their use favorable. Only a few of the Imhoff tanks built in that period in Ontario are still in operation. New tanks of this design have not been used in municipal plants for 20 years.

For secondary treatment two methods were used in the early days —contact filters and trickling filters. The latter found use in several plants before activated sludge was adopted. Following the latter's advent, and influenced by over-enthusiastic appraisal of its possibilities, trickling filters were completely lost sight of, even for small plants. The experience with activated sludge for these small municipalities and for institutions were not successful. Too much supervision was required for the non-technical personnel that was available. The pendulum is now swinging back to trickling filters for these smaller units, and use will be made of the later developments in this process.

Different factors have been responsible for the extensive use of the activated sludge process in Canada. There

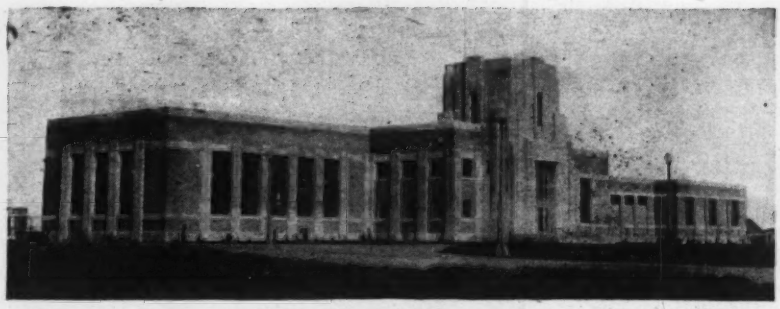


***Fig. 3. Forerunner of a predicted postwar boom in mechanized sewage disposal installations for Canada is the primary treatment plant at Winnipeg, Manitoba.***

are now 48 municipal plants, of which 30 are in Ontario. In addition to these the process has been employed at a number of institutions, such as hospitals. These plants were patterned after the English experience. Spiral flow tanks with agitation by air have been used exclusively, and until recently all air diffuser plates were the English type set in cast-iron frames. The first municipal plant of the activated sludge type built in Ontario was at Brampton in 1918, where sedimentation tanks were reconstructed.

Among the factors which led to this widespread use of activated sludge may be mentioned the following: Enthusiastic support of it in the early stages by the Ontario department of health; low initial costs; small loss of head involved; and low power costs for operation. Some of these early hopes were not well founded, but later developments, particularly in sludge handling were able to offset these deficiencies to some extent. Low electrical power charges have been a favorable feature in this process.

Power costs in Ontario plants vary to some degree but a figure between 5/10 and 6/10th cents per kw.-hr. may be taken to include all charges.

#### Sludge disposal difficulties

Sludge handling has been a difficult problem in Canadian disposal works. This was intensified with the introduction of the activated sludge process. Experience with undigested sludge brought severe odor problems. Digestion in heated tanks has overcome this, and good results are general. Sludge drying has passed through different stages. Canadian conditions were unfavorable for open drying beds but glass covering brought an improvement. In these, only sufficient heat has been necessary to prevent freezing. Favorable results have been experienced in some instances where the sludge was allowed to freeze on the drying bed, and removed either in this state or after it had thawed and dried.

Mechanical dewatering on vacuum filters has been the recognized procedure in recent years, both for large and small plants.

Sludge disposal for fertilizer production has been practiced at a number of Ontario plants of smaller capacities. Here the sludge is removed either in the wet state or after vacuum filtration. This method has not been used for the value of the fertilizer, but because of economical disposal. Apart from this, little effort has been made to use sludge as a fertilizer.

Chlorination of sewage has not been utilized to a great extent in Canada. Probably local conditions have been responsible for this, but it is fully anticipated that this treatment will increase greatly in the years to come for control at sewage plants.

#### Financing new work

A survey of water and sewerage needs was made recently for the province of Ontario, and the estimated expenditure was about $40 million for new waterworks, sewerage and treatment plants. This does not include the many extensions which would be required in existing systems, a figure which might reach as high as new installations. If all Canada were included, it is conservative to expect that this figure would be doubled.

In Ontario, and probably in all parts of Canada there is expected to be a major program in sewage treatment. The city of Toronto has already started on the first stage of a treatment plant, estimated to cost 9½ million dollars. Much of this will be for the postwar period. This is but an instance of the feeling in other centers respecting this necessary activity.

The question of financing these sewer systems and disposal works is primarily one for the local municipalities, and to this end the planning is now proceeding. This planning is not postulated on the basis that outside financial assistance will be forthcoming. If it does, so much the better.

The question of governmental assistance in finance is not yet clear. It is a known fact that the Dominion government has appointed a committee to advise on postwar reconstruction. That committee has been active, and while it is understood the report has been presented it is not yet made public. Statements credited to members of the federal government might indicate a trend towards financial assistance for works of this kind. If any municipal grants are forthcoming it is believed that waterworks and sewerage will be in the prior group.

If federal grants become available it is not clear as to the procedure which will be followed. Will the money be paid directly to the municipalities or will it be given to the provinces to be allocated to the municipalities where it is most needed? What proportion of the cost of the projects will be paid is likewise uncertain, but it is believed that something more concrete in respect to these questions may be looked for soon.

From this review of developments and prospects the most encouraging feature in Canada is that there is an optimistic viewpoint on what can be done in the sewerage field after the war. Environmental sanitation will be recognized to a greater extent. Sewage treatment will be installed to abate stream pollution, and it is anticipated this treatment will not stop halfway, but will be sufficient to give adequate results for each local situation.

## Brazilian Steel Production

Brazilian steel production, encouraged by constantly dwindling imports and increasing domestic demand, has jumped 39 percent in volume and over 90 percent in value, since the beginning of the war in Europe. Production which amounted to only 114,095 tons, and was valued at $4,508,450 in 1939, reached 159,614 tons valued at $8,872,200 in 1942, according to the Brazilian Government Trade Bureau.

# From Field and Office

ORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

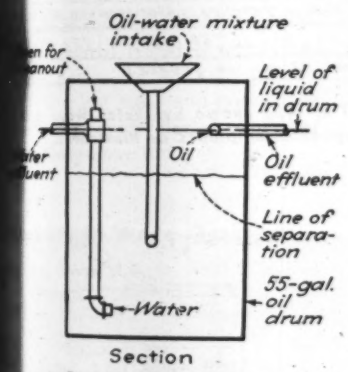
### Steel Drum Utilized for Oil-Water Separator

At one of the main Alaskan air es leaks were discovered in two ncrete tanks storing diesel fuel oil. e escaping oil was carried into a rby gully as an oil-water mixture a steady flow of groundwater. After leaks were noticed, additional ks under construction were given special water-proofing treatment. wever, the oil-soaked concrete in tanks in use could not be treated, the army engineers devised a clever p for recovering most of the leak- oil.

A standard steel oil drum, set on with top open, was fitted up with ee simple pipes. A pan collector ds the oil-water mixture to an in- e pipe in the drum that discharges influent into the drum slightly be- the center. The oil, separating m the water, rises to the top, where it is drawn off through a fixed effluent pipe.

The water is removed through another pipe, entering this pipe near the bottom of the drum but discharging at the same level as the oil pipe. A short nipple extending above the liquid level on the water pipe serves as a cleanout.

Measurement of the oil lost from the concrete tank compared with that caught by the trap shows a high rate of recovery.




1. Three pipes in a steel drum arate oil from water.

2. Top view of drum separator.

## Field and Office Comment

### Resistance Capacity Of Anchors or Deadmen

Sir: Engineers using the graphs for the resistance capacity of anchors or deadmen made available by Virgil A. Eberly in *ENR*, Dec. 2, 1943, p. 833 should not combine the action of two different materials such as concrete and earth. In accepting Mr. Eberly's data, a very careful analysis should be made, particularly in its application to transmission towers, footings, tank embedments, and other important structures.

Without going into the details concerning the $S$ "shear values" and how they are used in his formulae, the writer wishes to corroborate many of Mr. Eberly's statements in connection with this problem.

It was found from an extensive series of model tests on various shaped footings embedded at different depths in sand (a noncohesive granular soil) that

1. The total resistance to uplift is equal to the weight of a solid of earth forming a frustrum of a pyramid whose bases are: (a) the bottom of the footing, and (b) an area in the plane of the surface formed by an element of revolution moving through the periphery of the footing base at an angle $\phi$ with the vertical where angle $\phi$ is the angle of internal friction of the sand (Fig. 1).

2. The vertical displacement due to uplift varies in a straight line, the magnitude depending on the type of soil. This fact is important in the consideration of a factor of safety for design purposes.

3. The plane of rupture is not a straight line as indicated in (1) above, but is a paraboloid ($\phi$ varying). This fact was proven in the tests by embedding dry layers of plaster of paris at different levels from the top of the footing to the surface of the soil. The footing was then pulled to give sufficient displacement. The entire backfill was then completely inundated for the purpose of solidifying the layers of plaster of paris. This was done carefully to avoid disturbance to the backfill and to the powdered layers of plaster of paris. The water was next removed by drainage and sufficient time elapsed to allow for drying out. The backfill together with the

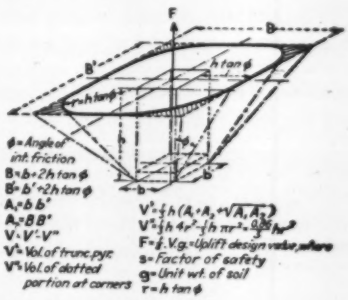

F
B
B'
h tan φ
φ = Angle of int. friction
B = b + 2h tan φ
B' = b' + 2h tan φ
A₁ = b b'
A₂ = B B'
V = V' + V''
V' = Vol. of trunc. pyr.
V'' = Vol. of dotted portion at corners
V = ⅓ h (A₁ + A₂ + √(A₁ A₂))
V = ⅓ h 4r² − ⅓ h πr² = 0.95 h r²
F = ½ V g = Uplift design value, where
s = Factor of safety
g = Unit wt. of soil
r = h tan φ

Fig. 1. Resistance of anchors to uplift equals weight of earth forming frustrum of a cone above anchor.

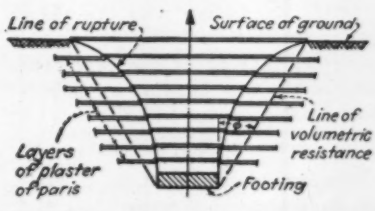



Fig. 2. Layers of plaster of paris in soil showed that plane of rupture of an anchor is not a straight line.

hardened layers of plaster of paris were then removed for examination. The plane of rupture was definitely marked on these hardened layers and gave a parabolic shape to the surface as shown by Fig. 2.

4. A factor of safety of 1½ for wind forces to 2 for static loads should be used on the value obtained in (1) above.

Where the backfill consists of clay, silt or mud, or where water is encountered, the designer should modify his $\phi$ and factor of safety values. The writer has used $\phi = 15$ deg. for clays and silts and $\phi = 30$ deg. for sands, and varied his factor of safety to 4 in extremely wet conditions, with the understanding that these $\phi$ values are empirical.

In extremely uncertain conditions the backfill should not be figured in at all, and the uplift resistance should be developed by means of mass concrete in the footing. — ABRAHAM WOOLF, *Structural Engineer, Albert Kahn Associated, Architects & Engineers, Inc., Detroit, Mich.*

## Simplified Detailing Of Pipe Bends

In detailing pipe bends quite often the data available are the projected angles which the center tangent of one or both sections of pipe makes with the axis or the cylindrical surface of a vessel, or the horizontal or vertical axis of some equipment. Two common cases are shown in Figs. 1 and 2.

In both cases the true angle required for fabricating the bend can be obtained by a very simple method requiring only a fraction of the time necessary by the standard method to obtain that angle by either making projections or using direct analytical methods.

In the case of Fig. 1, the accompanying table lists the values of the two projected angles $\alpha$ and $\alpha^1$ in two perpendicular planes with one plane passing through or being parallel to the center tangent of one pipe. The value of the true bending angle $\theta$ is given by the general formula

$$\tan\theta = \sqrt{\tan^2\alpha + \tan^2\alpha^1} \qquad (1)$$

This formula is based upon accurate deductions, but space does not permit publication of its proof.

For convenience of the detailer, the value of true angles has been tabulated for the more common values of the two projected angles in the table of Fig. 1. For values not tabulated the general formula should be employed.

In the case illustrated by Fig. 2 the center tangents of the two pipes making the bend, lie in two perpendicular planes, and the angles $\alpha$ and $\alpha^1$ made by the center tangents with the common intersection of the two planes are given.

The value of the true bending angle $\theta$ in this case is given by the general formula.

$$\cos\theta = (\cos\alpha)(\cos\alpha^1)$$

which could be proven if space permitted.

For convenience of the detailer the value of the true angle $\theta$ for the most common values of the angles $\alpha$ and $\alpha^1$ are tabulated in the table of Fig. 2. In this case for values not tabulated the general formula also should be used. —PETER J. MASCARO, *Engineer, Blaw-Knox Co., Pittsburgh, Pa.*

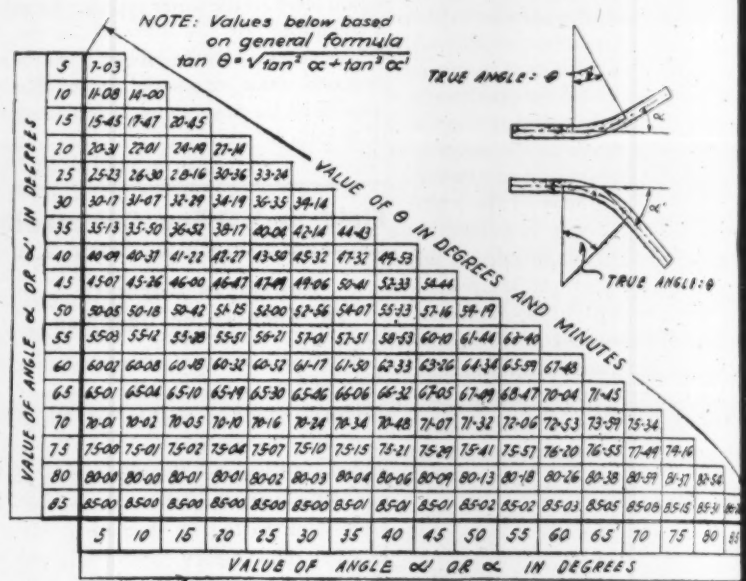

NOTE: Values below based on general formula
tan θ = √(tan² α + tan² α¹)
TRUE ANGLE = θ
α
α¹
TRUE ANGLE = θ
VALUE OF θ IN DEGREES AND MINUTES
VALUE OF ANGLE α OR α¹ IN DEGREES
VALUE OF ANGLE α¹ OR α IN DEGREES

**Fig. 1. True bending angle $\theta$ of pipe bend of type shown by sketch when given two projecting angles $\alpha$ and $\alpha^1$ in two perpendicular planes as illustrated.**

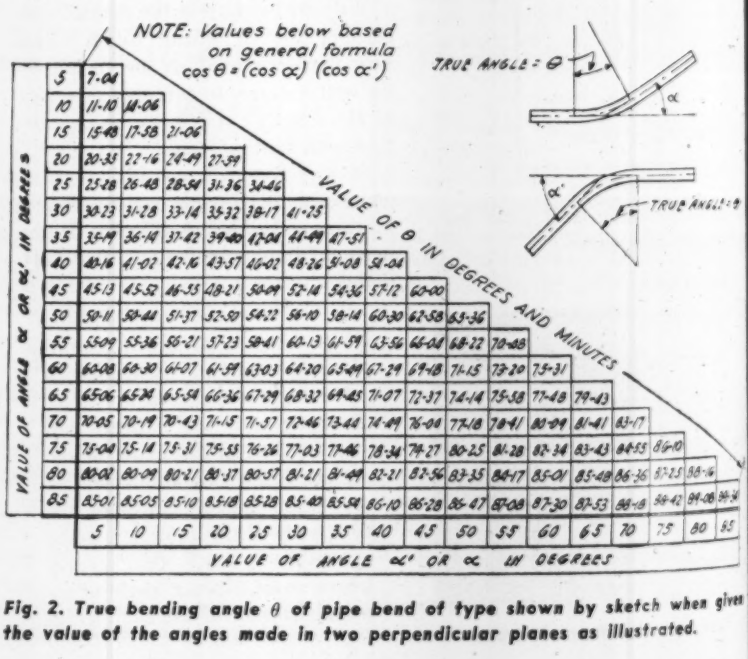

NOTE: Values below based on general formula
cos θ = (cos α) (cos α¹)
TRUE ANGLE = θ
α
α¹
TRUE ANGLE = θ
VALUE OF θ IN DEGREES AND MINUTES
VALUE OF ANGLE α OR α¹ IN DEGREES
VALUE OF ANGLE α¹ OR α IN DEGREES

**Fig. 2. True bending angle $\theta$ of pipe bend of type shown by sketch when given the value of the angles made in two perpendicular planes as illustrated.**

# Book Notes and Reviews

**The month's addition to the engineer's reading and reference list**

## Science Helps the War

CE AT WAR—By George W. Gray. 296 Harper & Brothers, New York, N. Y.

re is an assembly of facts that s the claims of advocates of the re Bill to set up a super research financed by a great appropria- of federal funds. Not written any such purpose in view, this nevertheless effectively denies harge of the supporters of that hat this country is not making ost of its research facilities and the establishment of a new body authority to explore war needs nitiate new research would aid ar effort. Under the direction of Office of Scientific Research and lopment all the research needed e armed forces is being carried by existing research agencies. vast program, costing over $100,- 00 a year, is using the services ost of the available engineers and tists.

is book covers most of those ele- s of current research which can ade public. In addition it goes to the last war, and sometimes er, to provide background for is being done today.

## swers to Wage Questions

AND HOUR MANUAL, 1943 Edition— Bureau of National Affairs, Inc., 1 M St., N.W., Washington, D. C. 50.

r those who must keep up to on federal action relating to s, hours of work and working itions, this manual will be of help. Actually, it is supplement similar manual issued in 1942, h should also be available for a lete coverage of court and ad- strative decisions concerning the al federal acts affecting such ers.

e trend of ruling of those charged administration of these federal toward bringing all work under laws, other than work specific- exempted by the laws, is shown ruling reported in the current edition of the manual with respect to research workers in a non-profit educational institution. As to whether these workers are engaged in interstate commerce, and so subject to the Fair Labor Standards Act, a regional attorney of the Wage-Hour Division said: "The fact that the employer of the research workers has reason to believe that the devices being developed will be produced for interstate shipment is sufficient, in our opinion, to bring those workers within the coverage of the act."

That finding should make those in charge of college laboratories doing commercial research give thought to the question of whether the pay and working conditions of the men in their laboratories conform to the requirements of this federal law.

## Prestressing Concrete

PRESTRESSED REINFORCED CONCRETE—By Kurt Billig. 248 pp. Obtainable from F. Billig, 151-14 85th Ave., Jamaica, N. Y. $5.

Part I of this book is largely devoted to a summary of the development of prestressed reinforced concrete from its early inception to date, including concise descriptions of the various methods employed by outstanding authorities, also to the description of a number of basic applications to actual structures as well as the result of load tests conducted on prestressed reinforced concrete pipes, posts and girders, and load and fire tests on prestressed concrete slabs.

Derivations of formulas for the complete design of prestressed reinforced concrete members subjected to pure tension and to bending are given in Part II of the book, which carries out in great detail the actual design of I-shaped prestressed reinforced concrete beams from 12 to 24-in. depth. The characteristics of the beams as well as their load carrying capacity for various length to deflection ratios are given in tabulated form. Two sets of beams are so tabulated, one for prestressed reinforcing in one flange only, the other for symmetrical reinforcement in both flanges.

The book is a valuable tool for the engineer interested in the design of prestressed reinforced concrete structures, furnishing useful information regarding the relative advantages of different grades of steel and concrete used, the evaluation of the effective amount of reinforcement, the appropriate extent of the prestress, the determination of deflection, the effect of prestress on bond, shear and principal stress, and the determination of safety factors.—*Reviewed by* R. L. BERTIN, *chief engineer, White Construction Co., New York.*

## Mostly About Concealment

MODERN AIRFIELDS: PLANNING AND CONCEALMENT—By Major Merrill E. DeLonge. 167 pp. Pitman Publishing Corp., New York; Sir Isaac Pitman & Sons, London. $4.

This little book deals almost exclusively with the location, design and construction of military airfields with the object of making them as inconspicuous as possible from the air. It is written for military use, not for the builders of commercial airports. For the designers of army airfields, it brings together in concise form the available information on concealment of the fields and their service facilities.

Many will question Major DeLonge's proposal that concealment be considered in selecting commercial airfield sites.

## "Muchas Palabras"

ENGINEERS' DICTIONARY — Spanish-English and English-Spanish—By Louis A. Robb. 423 pp. John Wiley & Sons, New York 16, N. Y., Chapman & Hall, London. $6.

There are eighteen Spanish-speaking countries south of the border, and there are just about as many local variations in the meaning of some words—particularly those concerned with technical matters. For example, a sewer in Latin America may be called *cloaca, albanal, alcantarilla, albollon, conducto de desague* or *desaguadero,* and a concrete mixer, which is generally known as a *hormigonera* or *mezcladora* also may be termed a *revolvedora* (in Mexico) or a *terceadora* (in Venezuela).

Recognition of this fact gives to Mr. Robb's book a practical value that sets it apart from most technical dictionaries. And it has a further special appeal for civil engineers and construction men, because the vocabu-

lary is designed specifically for this group.

Mr. Robb, vice president of the Ambursen Engineering Co., has been working with Spanish-American engineers for more than a quarter of a century, and his dictionary represents the compilation of 44,000 terms that are required in handling plans, specifications, reports and contracts on construction work.

If Mr. Robb should ever seek to embellish the thorough job he has done, he might consider the addition of Portuguese equivalents to satisfy the needs of those who are engaged with affairs in Brazil.

## Miscellaneous Notes on Booklets and Reprints

PUBLISHED ARTICLES on municipal water treatment plants in the United States, indexed according to cities, are listed in Bulletin No. 5 of the Louisiana State University Engineering Experiment Station. Copies are available from the Louisiana State University Press, Baton Rouge, at 50 cents each.

MUCH USEFUL INFORMATION on the status of highway development in this country is contained in a pamphlet "The Role of the Federal Government in Highway Development" which was prepared by G. Donald Kennedy, vice president of the Automotive Safety Foundation for the Special Committee on Postwar Economic Policy and Planning of the U. S. Senate. Mr. Kennedy also is chairman of the A.S.C.E. Committee on Postwar Planning. Copies of the document, which is characterized as a Senate Committee Print, 78th Congress, 2nd Session, can be obtained from the Automotive Safety Foundation, Washington, D. C., or from the Superintendent of Documents.

A SET OF LOOSE-LEAF SHEETS entitled "Basic Problems in Descriptive Geometry" has been published by The Ronald Press Co., New York, ($1.75), for use with any standard text on descriptive geometry. Prepared by William W. Turner and Carson P. Buck of the University of Notre Dame, these sheets are similar to those published by Prof. Turner last year under the title "Basic Problems in Engineering Drawing."

## New Engineering Books

ENGINEERS' DICTIONARY, Spanish-English and English-Spanish—By Louis A. Robb. 423 pp. John Wiley & Sons, New York 16, N. Y. $6.

PRACTICAL DESIGN OF WELDED STEEL STRUCTURES—By H. M. Priest. 145 pp. American Welding Society, New York 18, N. Y. $1.

ABBREVS. (A Dictionary of Abbreviations)—By Herbert John Stephenson. 126 pp. The Macmillan Co., New York. $1.75.

FINAL REPORT OF COMMISSIONERS OF SEWERAGE OF LOUISVILLE—1919-1942. 894 pp. Published by the Commission at Louisville, Ky.

WAGE AND HOUR MANUAL, 1943 Edition—705 pp. Bureau of National Affairs, Inc., Washington 7, D. C. $7.50.

STRENGTH OF MATERIALS—By Harvey F. Girvin. 354 pp. International Textbook Co., Scranton 9, Pa. $3.

MODERN AIRFIELD PLANNING & CONCEALMENT—By Merrill E. DeLonge, Major, Army Air Corps. 164 pp. Pitman Publishing Corp., New York 19, N. Y. $4.

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THE ROLE OF THE CONSTRUCTION INDUS... IN POST-WAR YEARS—Canadian Constr... tion Association, Ottawa, Ont.

MODERN URBAN HIGHWAYS—By G. Don... Kennedy. Conference Committee on ... ban Problems, 1615 H St. N.W., Wa... ington 5, D. C.

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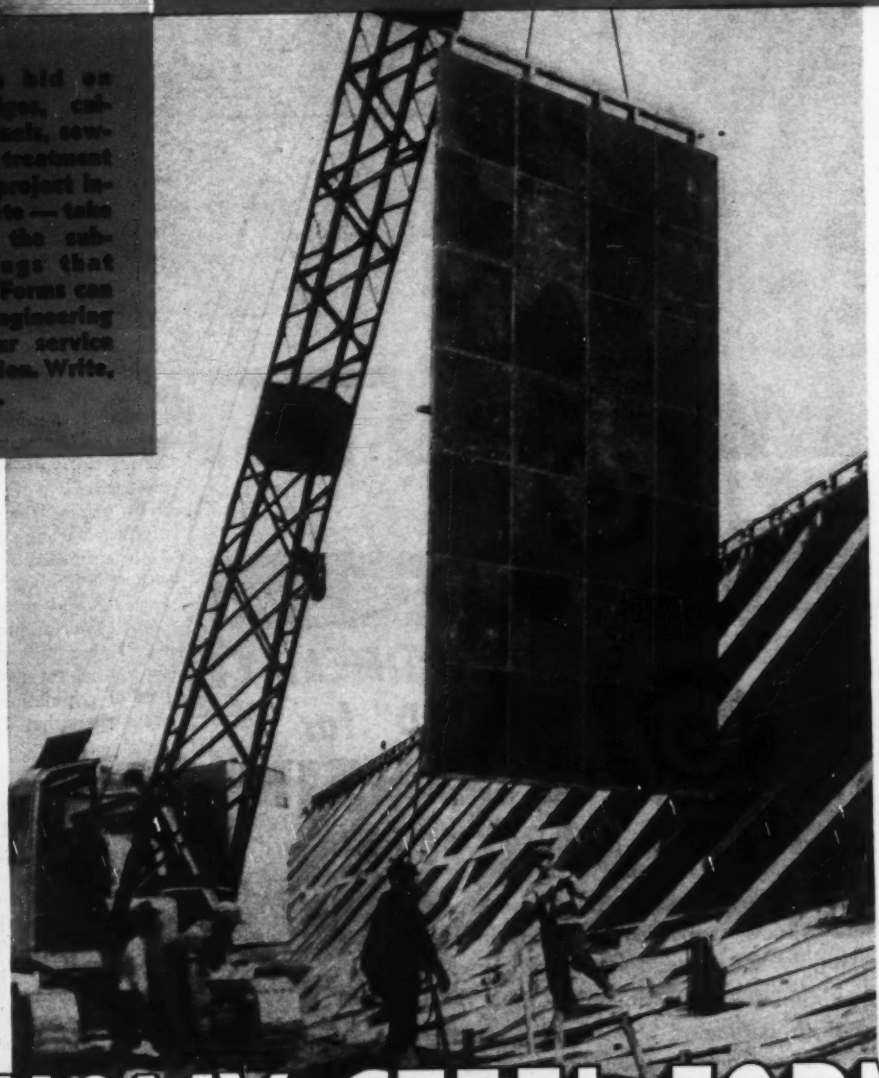

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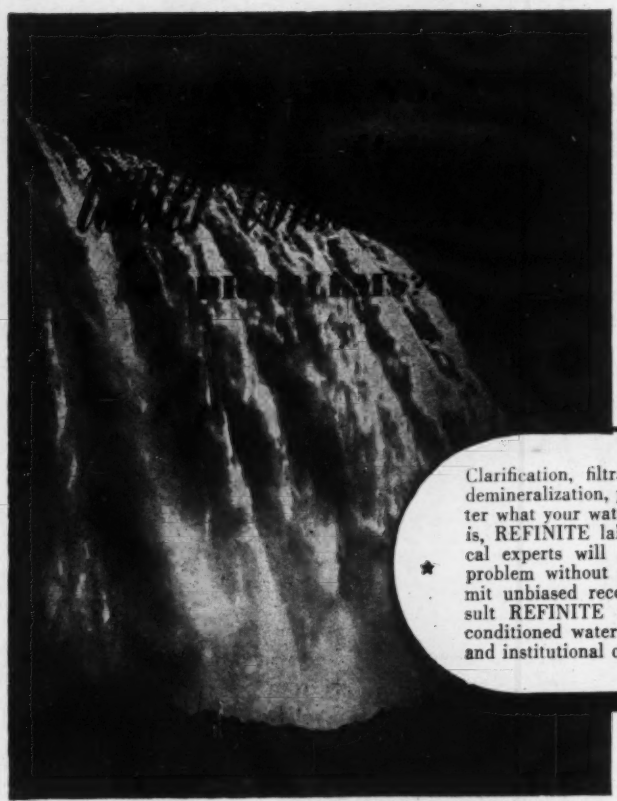
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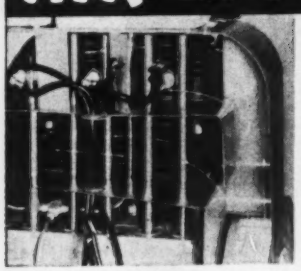

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## NEWS OF THE WEEK

(*Continued from p. 91*)

### A $40,000,000 freeway proposed in Baltimore

A plan to build an eight-lane freeway directly across the central part of Baltimore at an estimated cost of $40,000,000 was recommended to Mayor McKeldin on Feb. 23 by the Downtown Committee. The committee recommends that construction of such a freeway be made the city's No. 1 postwar project in preference to the bypass route favored by the State Roads Commission. The latter route includes a high-level toll bridge over Baltimore harbor.

The proposed freeway would extend from east to west across the city north of the main business district and would occupy the entire block between Jefferson and Orleans streets in the eastern part of the city and between Franklin and Mulberry streets in the western part of the city for a total distance of 42 blocks. It would be largely depressed below the north and south streets except across the valleys, where it would be elevated.

In urging the construction of this highway through the city in preference to the proposed bypass route around the city to the south, the Downtown Committee called attention to the recent report of the National Inter-regional Highway Committee, which favors carrying arterial routes directly through the centers of population rather than around them where that is found to be practical.

. . .

### Pennsylvania has 254 covered wooden bridges

A total of 254 covered wooden bridges remained on the Pennsylvania Department of Highway's System as of January 1, 1944, Secretary John U. Shroyer has announced.

The majority of these bridges have a safe carrying capacity of only two or three tons, and are posted for that load-age.

The oldest is the "Northbrook Bridge" which crosses the West Branch of Brandywine Creek in Pocopson-West Bradford Township, Chester County. It was built in 1807.

In 1938 Henry Ford purchased a 105-year old covered wooden bridge from the Department, and had it removed to his early American village at Dearborn, Mich.

Most of the picturesque spans are of virgin pine "nailed" together by

# Prewar "PARADE OF PROGRESS" set the style for wartime structures

Its 80 x 152-foot inside area provided for 1,500 spectators

Built in 1941 for a traveling exhibition, the war stopped the use of this unusual tent. But what was learned in its construction and handling came in very handy when military men asked for equipment of comparable design.

Curved aluminum alloy ribs, spot-welded assemblies of extruded shapes and sheet, radiate from arc-welded aluminum spiders. (The latter were heat treated to give them high strength.) Decorative entrances were made of aluminum alloy tubing. From this structural framework was suspended the fabric covering; no interior supports to interrupt the vision or impair the acoustics.

Lightweight aluminum, in combination with this unique construction, made the structure easy to transport, speedy and simple to erect. It was carried on two trucks. Rib sections had a maximum length of thirty-five feet. They weighed no more than 400 pounds each. Fewer than 200 bolts were needed for erection of this huge framework.

Aluminum is performing many duties today in the military services. Prewar aluminum equipment is giving an excellent account of itself in war industries. Many postwar uses are suggested by this enviable performance record. ALUMINUM COMPANY OF AMERICA, 2108 Gulf Building, Pittsburgh, Pennsylvania.

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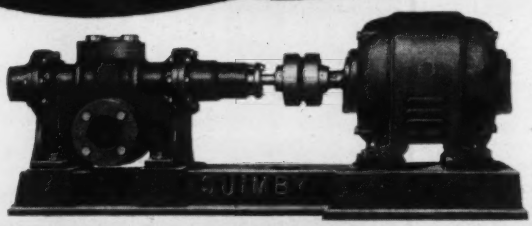

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antiquated wooden pins.

Flood waters have little effect on these bridges because the bridges were built on a slight elevation, and high waters flow around the bridge and over the road approaches.

• • •

## Chicago promotes its subway engineers

Several promotions were awarded on Feb. 16 to top ranking engineers in the Department of Subways and Superhighways of the city of Chicago, the department which designed and built the recently completed State Street subway.

Virgil E. Gunlock, formerly engineer of construction is the new chief subway engineer, succeeding Charles E. DeLeuw, who has returned to private consulting practice in Chicago. Mr. Gunlock's service record with the City's engineering department has been one of progressive advancement. He graduated with honors in civil engineering from the University of Illinois in 1927 and immediately joined the technical staff of the Chicago Sanitary District. In 1939, Mr. Gunlock was among those engineers given leaves from the Sanitary District to form the nucleus of the engineering organization for the Department of Subways and Superhighways. He was appointed resident engineer on the first unit of the Clybourn-Division Street section of the State Street subway to go into construction, advancing to assistant engineer of construction early in 1940 and to engineer of construction in October of the same year.

### New engineer of design

Walter E. Rasmus, formerly mechanical engineer, was appointed engineer of subway design, succeeding Hans C. Johnsen, who has returned to his former position with the technical staff of the Sanitary District. Mr. Rasmus, a civil engineering graduate of the University of Illinois in the year 1920, has spent five years with a Chicago consulting engineering firm before joining the Sanitary District. He has been with the Department of

# BIGGER PAY LOADS

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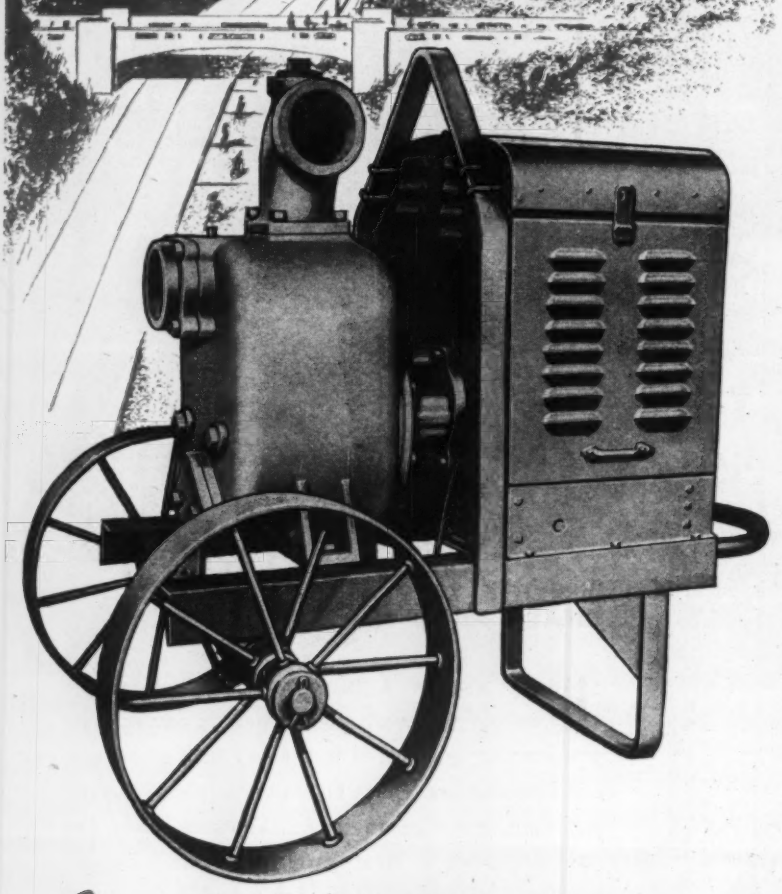

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From every standpoint—first cost, operating expense, downtime and repairs, and length of useful life—CARVERS cut pumping costs. Fast-priming, efficient, non-clogging and simply designed with extra strength and life in every part, CARVERS get to work faster, stay on the job longer and *get more done!*

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Subways and Superhighways since 1939.

Dick Van Gorp is the new assistant chief subway engineer, having been advanced from principal assistant engineer. A graduate in civil engineering of the University of Iowa in 1926, Mr. Van Gorp immediately joined the engineering staff of the Sanitary District. From 1932 to 1934 he was employed by the Illinois Division of Highways, returning then to his former position with the Sanitary District, and later transferring to the Subway Department.

**Girard assumes new duties**

Appointment of a new assistant chief subway engineer was necessitated by the recent creation of the City of Chicago's Engineering Board of Review, which has been entrusted with the task of coordinating and integrating all major municipal construction projects in the Chicago area preparatory to postwar building. In this connection Peter F. Girard, formerly assistant chief subway engineer has been transferred to the post of projects engineer and will have active charge and supervision of this important postwar activity.

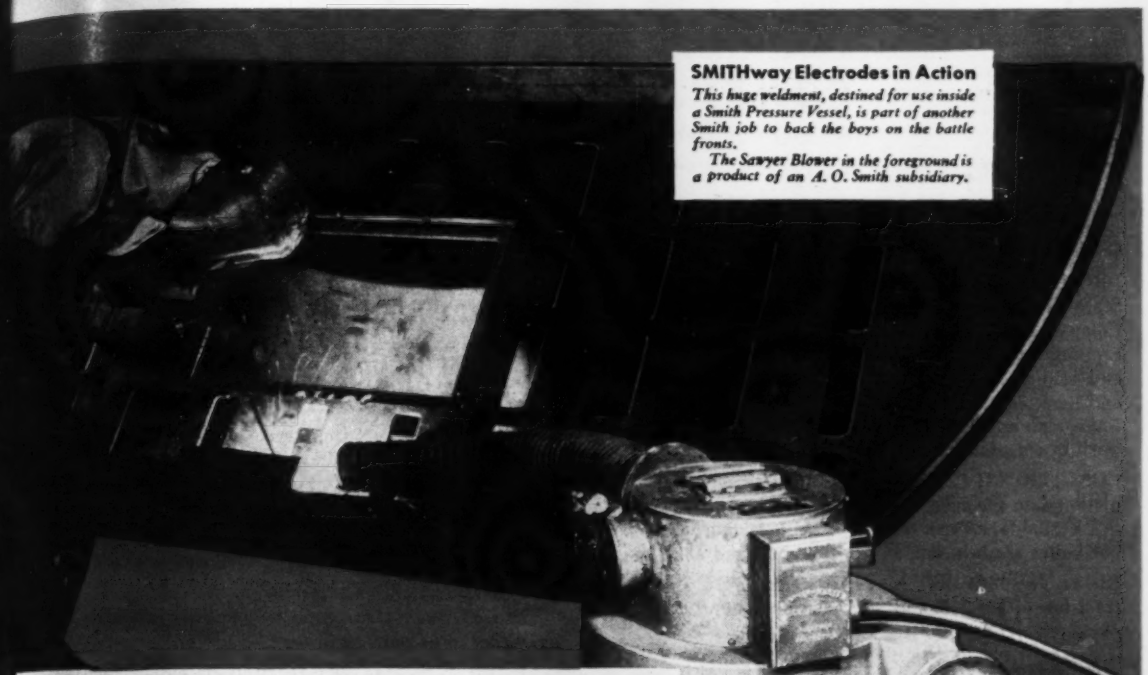
. . .

## *Milwaukee will engage in large-scale housing*

Taking advantage of little known provisions in the comprehensive Wisconsin "Housing Authorities Law," the Common Council of Milwaukee, recently moved to empower that city to engage in the housing business on a large scale. All that was required under this law was for the council to declare that need for a housing authority exists, following which, the mayor is required to appoint a five-man commission to direct operations. This commission has not yet been appointed.

Within the limitation that the housing must be for low income groups, although such groups are not clearly defined, the city will have extremely broad powers for housing development. For instance, it may condemn property in the city or within a radius of five miles outside the city limits, provided such areas do not include any other town or village.

The authority may buy property or receive it as a gift from individuals, the city of Milwaukee, or from the federal government. This latter provision is



**SMITHway Electrodes in Action**

*This huge weldment, destined for use inside a Smith Pressure Vessel, is part of another Smith job to back the boys on the battle fronts.*

*The Sawyer Blower in the foreground is a product of an A. O. Smith subsidiary.*

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***SMITHway AC Welding Machine*** *eliminates arc blow; reduces spatter losses; saves power.*

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# CONTRACT UNIT PRICES

***What contractors are bidding on different kinds of construction work***

## CHANNEL PROTECTION, OHIO

OWNER: Ohio State Dept. of Highways, Columbus.

PROJECT: Channel protection on Section Mansfield along State Highway No. 501, U. S. Highway 30-N, Richland County, Ohio. Project involves channel excavation, riprapping, sewers and underdrains, topsoiling, flowline paving, and seeding and sodding for roadway areas; and cofferdams and pumping, wet and dry structure excavation, concrete for walls, slab and footings, waterproofing, and other apurtenant work in connection with construction of erosion-control dam.

CONDITIONS: Contractor to furnish all materials. No completion date specified. Rail and highway transportation facilities available. Wage rates are: skilled labor, $1.15 to $1.75 per hour; semi-skilled, 82½c. to $1.25; and common, 82½c.

BIDS: Two bids were received December 14, 1943, the contract low of $31,136, and $35,406. Estimate, $32,200.

LIST OF BIDDERS:

1. Purdy Constr. Co., Mansfield, Ohio (contract) ..... $31,136
2. Pierce Constr. Co., Toledo, Ohio ..... 35,406

| Item | Quan. | Unit Prices (1) | (2) | (3)* |
|---|---|---|---|---|
| 1. Channel excavation | 2,939 c. y. | $2.25 | $1.25 | $1.25 |
| 2. 18-in. type B riprap | 1,600 s. y. | 3.75 | 9.00 | 8.00 |
| 3. 18-in. grout filled, type B riprap | 30 s. y. | 3.75 | 10.00 | 8.50 |
| 4. 18-in. pl. cem. conc. pipe for storm sewer | 72 l. f. | 3.25 | 3.00 | 2.60 |
| 5. Topsoil, 2-in. thick | 90 s. y. | .45 | .60 | .12 |
| 6. 6-in. pl. cem. conc. pipe for underdrain | 12 l. f. | 1.25 | 1.00 | 1.20 |
| 7. Flowline paving | Lump Sum | 800.00 | 4,500.00 | 300.00 |
| 8. Seeding and protecting rdway areas | 6,065 s. y. | .08 | .10 | .07 |
| 9. Commercial fertilizer (4–12–4) | 1,092 lb. | .035 | .06 | .05 |
| 10. Cofferdams and pumping | Lump Sum | 4,500.00 | 500.00 | 5,000.00 |
| 11. Wet excavation, structures | 290 c. y. | 4.00 | 3.00 | 3.50 |
| 12. Dry excavation, structures | 50 c. y. | 4.00 | 2.50 | 2.75 |
| 13. Class E conc., walls and slab | 160 c. y. | 40.00 | 35.00 | 30.00 |
| 14. Class E conc., footings | 87 c. y. | 30.00 | 25.00 | 20.00 |
| 15. Type B waterproofing | 22 s. y. | 2.50 | 2.50 | 2.25 |
| 16. Reinforcing steel | 11,734 lb. | .08 | .08 | .07 |
| 17. Struct. contraction joint | 29 l. f. | 1.00 | 5.00 | 2.00 |
| 18. Porous backfill | 75 c. y. | 2.50 | 4.00 | 3.00 |
| 19. Sodding slopes | 90 s. y. | .90 | .50 | .55 |
| 20. Erecting and maintaining lights, signs, barricades and watchmen | Lump Sum | ..... | 300.00 | 50.00 |
| 21. Premium on industrial insurance | Lump Sum | 637.00 | 525.00 | 533.82 |

* *Engineer's estimate.*

## ROAD SURFACING, UTAH

OWNER: Utah State Road Comn., Salt Lake City.

PROJECT: Plant-mix bituminous road surfacing between Wendover and Knolls, in Tooele County, Utah. Length of project 16.4 miles; roadway width, 32-ft.; surfacing, 26-ft.

CONDITIONS: Contractor to furnish all materials and complete work in 240 working days. Rail and highway transportation facilities available. Wage rates are: skilled labor, $1.375 to $1.50 per hour; semi-skilled, $1.00 to $1.10; common, 75c.

BIDS: Ten bids were received Nov. 17, 1943, ranging from the contract low of $469,875 to $733,380. Estimate, $507,632.

LIST OF BIDDERS:

1. Jeff Hunt & F. M. Frandsen, Reno, Nev. (contract) ..... $469,875
2. Ryberg Co. and Strong & Grant, American Fork, Utah ..... 478,922
3. Olof Nelson Constr. Co., Logan, Utah ..... 483,733

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. Plant-mix bituminous surfacing | 46,000 gal. | $2.40 | $2.50 | $2.75 |
| 2. Bituminous mat'l., type RC-5 | 64,000 gal. | .11 | .12 | .105 |
| 3. Bitum. mat'l., 200–300 penetr. | 530,000 gal. | .09 | .10 | .095 |
| 4. Bitum. mat'l., type MC-1 | 60,000 gal. | .11 | .11 | .105 |
| 5. Cr. gravel or cr. rock surf. crse | 110,000 ton | 1.45 | 1.30 | 1.35 |
| 6. Pit run gravel | 25,000 ton | 1.25 | 1.20 | 1.30 |
| 7. Cover material | 3,450 ton | 3.25 | 4.00 | 3.00 |
| 8. Unclassified excavation | 143,000 c. y. | .27 | .25 | .30 |
| 9. Overhaul, Class A | 800,000 sta. y. | .015 | .01 | .01 |
| 10. Overhaul, Class B | 550,000 y. mi. | .06 | .09 | .10 |
| 11. Watering | 500 M gal. | 1.50 | 2.00 | 1.00 |
| 12. Rolling | 600 hr. | 6.00 | 5.00 | 4.50 |
| 13. Excavation for structures | 1,000 c. y. | 1.50 | 4.00 | 2.00 |
| 14. Lumber (untreated) | 53.7 Mbm. | 125.00 | 160.00 | 125.00 |

## HIGHWAY IMPROVEMENTS, NEVADA

OWNER: Nevada Department of Highways, Carson City.

PROJECT: Improving a portion of the state highway system in Elko County, Nev. (Route 1, Section B), from six miles east of Elko to one-half mile east of the North Fork Bridge. Length of project is 9.815 miles. Includes paving with bituminous materials, grading, and drainage structures.

CONDITIONS: Contractor to furnish all materials. Rail and highway transportation facilities available. Prevailing wages to be paid on project.

BIDS: Nine bids were received December 23, 1943, ranging from the contract low of $308,335 to $446,989.

LIST OF BIDDERS:

1. Carl E. Nelson Co., Logan, Utah (contract) ..... $308,335
2. Gibbons & Reed Co., Salt Lake City, Utah ..... 332,568
3. Isbell Constr. Co., Reno, Nev. ..... 356,053

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. 95-hp. tractor with bulldozer or angledozer | 40 hr. | $6.00 | $7.00 | $6.00 |
| 2. 95-hp. tractor with carryall | 65 hr. | 6.00 | 8.00 | 10.00 |
| 3. Motor grader | 152 hr. | 4.00 | 5.00 | 4.00 |
| 4. 1½-ton dump truck | 100 hr. | 3.00 | 3.00 | 3.00 |
| 5. ¼-ton pickup | 165 hr. | 2.00 | 2.00 | 2.00 |
| 6. Specia' detours (force account) | Force Acc't. | 4,000.00 | 4,000.00 | 4,000.00 |
| 7. Selected detour surfacing | 21,475 ton | .28 | .22 | .20 |
| 8. Haul, sel'd detour surfacing | 25,285 ton mi. | .06 | .07 | .10 |
| 9. Liquid asphalt, MC-2, prime detours | 205 ton | 22.00 | 22.00 | 21.00 |
| 10. Signs | Lump Sum | 500.00 | 400.00 | 500.00 |
| 11. Remove fence | 41,114 l. f. | .03 | .05 | .05 |
| 12. Remove concrete | 92 c. y. | 5.00 | 8.00 | 6.00 |
| 13. Remove culvert pipe | 1,410 l. f. | 1.00 | 1.00 | 1.00 |
| 14. Remove headwalls | 62 ea. | 5.00 | 20.00 | 5.00 |
| 15. Remove cattle guard | Lump sum | 100.00 | 300.00 | 50.00 |
| 16. Move signs (force account) | Force Acc't. | 150.00 | 150.00 | 130.00 |
| 17. Remove, relay existing surface | 800 s. y. | .30 | .50 | .50 |
| 18. Roadway excavation | 303,907 c. y. | .14 | .16 | .20 |
| 19. Drainage excavation | 2,921 c. y. | .30 | .25 | .50 |
| 20. "V" type ditches | 163 sta. | 3.00 | 3.50 | 2.50 |
| 21. Borrow | 43,890 c. y. | .18 | .24 | .20 |
| 22. Slope rounding | 275 sta. | 5.00 | 3.00 | 10.00 |
| 23. Overhaul (yard stations) | 1,261,548 y. sta. | .008 | .01 | .01 |
| 24. Overhaul (yard mile) | 57,206 y. mi. | .10 | .10 | .10 |
| 25. Tamping roller | 2,003 hr. | 5.00 | 5.00 | 5.00 |
| 26. Power roller | 668 hr. | 5.00 | 4.00 | 5.00 |
| 27. Structure excavation | 2,361 c. y. | 1.00 | 1.25 | 1.00 |
| 28. Backfill | 1,985 c. y. | .50 | 1.00 | 1.00 |
| 29. Subgrade, type B | 9.82 mi. | 200.00 | 200.00 | 250.00 |
| 30. Roadside clean-up | Force Acc't. | 500.00 | 500.00 | 500.00 |
| 31. Water | 10,525 M gal. | 1.25 | 1.10 | 1.00 |
| 32. Type 1, gravel base | 117,288 ton | .35 | .33 | .30 |
| 33. Type 2, gravel base, 1-in. | 45,798 ton | .42 | .55 | .60 |
| 34. Liquid asphalt, MC–1 (prime) | 379 ton | 22.00 | 23.00 | 21.00 |
| 35. Liq. asph. type MC–2 (seal shldrs.) | 53 ton | 22.00 | 22.00 | 21.00 |
| 36. Asph. cement, 200–300 pen' seal plantmix | 119 ton | 21.00 | 23.50 | 21.00 |
| 37. Screenings | 904 ton | 2.50 | 3.00 | 2.50 |
| 38. Liq. asph., type MC–2 or MC–3 (roadmix shoulders) | 819 ton | 22.00 | 22.00 | 21.00 |
| 39. Roadmix shoulders | 19.53 mi. | 300.00 | 225.00 | 300.00 |
| 40. Asph. cem. (200–300 pen. plantmix) | 969 ton | 20.00 | 21.00 | 19.00 |
| 41. Class F–2 plantmix bitum. surface | 17,614 ton | 1.60 | 1.85 | 1.90 |
| 42. Class A concrete | 514 c. y. | 30.00 | 28.00 | 33.00 |
| 43. Class B concrete | 67 c. y. | 30.00 | 35.00 | 35.00 |
| 44. Reinforcing steel | 52,780 lb. | .07 | .09 | .07 |
| 45. 30-in. rein. conc. pipe | 358 l. f. | 6.00 | 8.00 | 6.50 |
| 46. 36-in. rein. conc. pipe | 435 l. f. | 8.00 | 11.00 | 9.50 |
| 47. Relay culvert pipe | 1,021 l. f. | 1.00 | 1.00 | 1.00 |
| 48. Grouted hand-laid riprap | 29 c. y. | 20.00 | 15.00 | 20.00 |
| 49. Move pipe culvert headwalls | 15 ea. | 20.00 | 15.00 | 20.00 |
| 50. Culvert markers | 86 ea. | 4.00 | 5.00 | 4.00 |
| 51. Guide posts | 38 ea. | 4.00 | 5.00 | 4.00 |
| 52. Reconstruct fence | 40,267 l. f. | .08 | .08 | .08 |
| 53. Monuments | 72 ea. | 5.00 | 5.00 | 4.00 |
| 54. 24-in. plain concrete pipe | 1,140 l. f. | 3.50 | 5.00 | 4.00 |
| 55. Paved turnout ditches | 950 l. f. | .50 | .25 | .50 |
| 56. Timber cattle guard | 1 ea. | 500.00 | 650.00 | 500.00 |
| 57. Remove and reconstruct cattle guard | Lump Sum | 500.00 | 500.00 | 400.00 |
| 58. Move gates | 9 ea. | 10.00 | 12.00 | 15.00 |

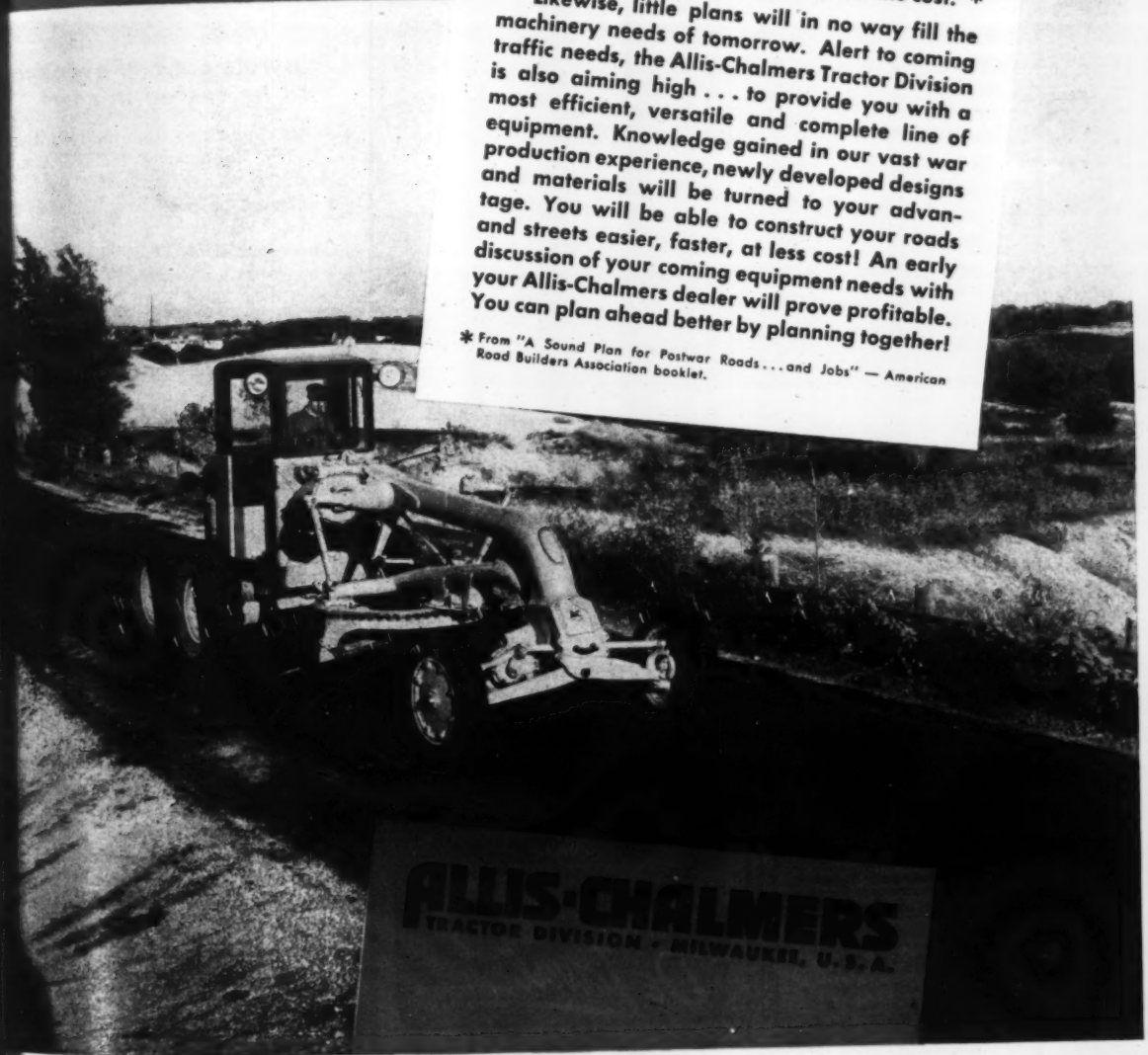
# AIM HIGH

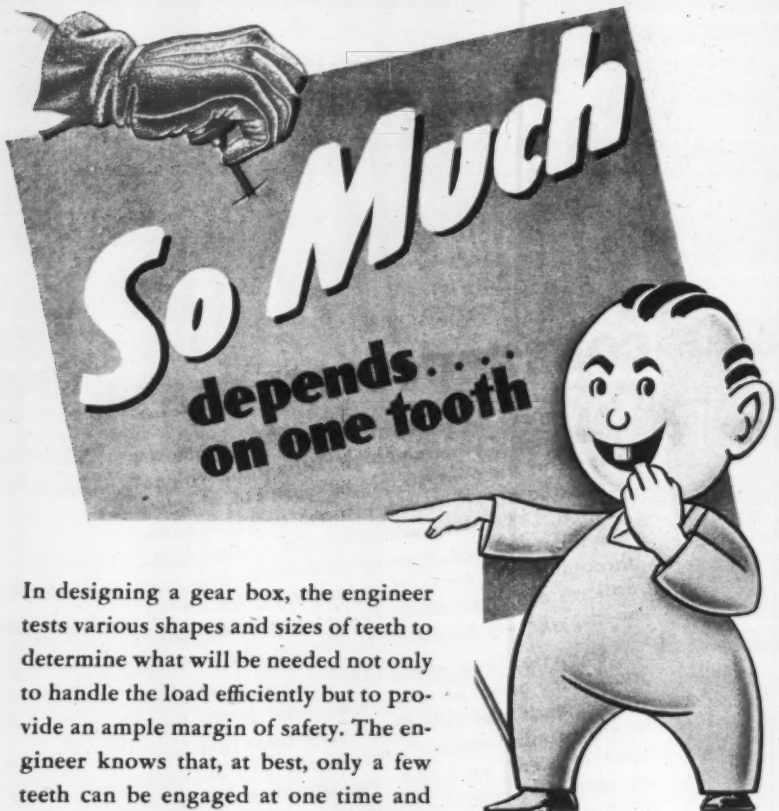
## ON YOUR POSTWAR CONSTRUCTION PLANS

"In planning the postwar highway program, the sights should be aimed high. Little plans will not get rid of the over-supply of worn out, obsolete roads and streets, unsafe bridges, and traffic congestion. Little plans will not build express highways between cities or arterial routes into and through cities. A sound program, based on the nation's economic needs and on actual highway needs, will pay dividends far beyond the cost." *

Likewise, little plans will in no way fill the machinery needs of tomorrow. Alert to coming traffic needs, the Allis-Chalmers Tractor Division is also aiming high . . . to provide you with a most efficient, versatile and complete line of equipment. Knowledge gained in our vast war production experience, newly developed designs and materials will be turned to your advantage. You will be able to construct your roads and streets easier, faster, at less cost! An early discussion of your coming equipment needs with your Allis-Chalmers dealer will prove profitable. You can plan ahead better by planning together!

* From "A Sound Plan for Postwar Roads . . . and Jobs" — American Road Builders Association booklet.






In designing a gear box, the engineer tests various shapes and sizes of teeth to determine what will be needed not only to handle the load efficiently but to provide an ample margin of safety. The engineer knows that, at best, only a few teeth can be engaged at one time and these may be called on to carry the maximum shock load. That's why the design of the individual "tooth" becomes so important. The present shape of the teeth in a Fuller gear is the result of a tremendous amount of research plus continuous field tests. You see the answer in the added wear-life . . . the smooth shifting . . . the quiet running of Fuller transmissions.

FULLER MANUFACTURING COMPANY, KALAMAZOO, MICHIGAN
*Transmission Division*
*Unit Drop Forge Division, Milwaukee, Wisconsin*

**GUNITE**

***New Construction—Repairs***

| | |
|---|---|
| Prestressed Tanks | Steel Encasements |
| Reservoir Lining | Dam Repairs |
| Pen Stock Lining | Tunnel Lining |
| Smoke Stack Lining | Sewer Repairs |

Disintegrated Concrete Abutments Renewed

Repairs To All Types of Masonry

*Write for our Bulletins*

**PRESSURE CONCRETE CO.**
*Engineers & Gunite Contractors*
1st Nat. Bank Bldg. FLORENCE, ALA.
6 Avenue B NEWARK, N. J.

DE LAVAL STEAM TURBINE CO. TRENTON, N.J.

*Manufacturers of* STEAM TURBINES
HELICAL AND WORM GEARS
PUMPS
Centrifugal, Propeller, Clogless, Mixed Flow
PUMP PRIMING SYSTEMS
CENTRIFUGAL BLOWERS AND COMPRESSORS
DE LAVAL-IMO OIL PUMPS

De Laval STEAM TURBINE CO. TRENTON 2, NEW JERSEY


especially designed to permit cooperation with the federal government in public housing. Also the housing authority may issue bonds to finance purchase or new construction and it may buy, sell or lease housing properties. One stipulation, however, is that the city may not engage in housing for profit.

**Projects tax exempt**

All projects of the housing authority will be considered by law as public property and therefore not subject to tax. Likewise, any bonds issued will be tax exempt. The authority may, however, pay the city for local services not to exceed what the city would collect in taxes for such services, if the projects were not exempt.

Housing authority projects, in addition to being authorized by the common council, must be approved by the local planning commission. Also, they must conform to building, health or other codes.

. . .

## *Iowa's control over dams to be tested in court*

An application from the Iowa Hydro-Electric Cooperative for a license to dam the Cedar River for power development purposes was denied by the Federal Power Commission recently. The commission took this action as a step toward obtaining a court test of the Iowa laws with respect to the construction of dams in navigable streams. The application has been before the commission for two and one half years.

The project would consist of an 8,300-ft. dam across the Cedar River about 21 miles upstream from its confluence with the Iowa River, a reservoir of about 11,000 acres in area, a powerhouse having four turbo-generating units with an aggregate generating capacity of 70,000 hp., and a discharge canal about 6,000 ft. long running parallel to the Mississippi River and discharging into the pool below U. S. Dam No. 16 near Muscatine, Iowa.

According to the commission, section 9B of the Federal Power Act requires that an applicant show compliance with requirements of the laws of the state concerned, before a license is issued. In this case the state of Iowa, which was granted leave to intervene, pointed out that the Iowa code provides that no dam shall be constructed "in any navigable or meandered stream for any purpose, or in any other stream for power purposes, unless a permit has been granted" by the State Executive Council.

The cooperative organization contended that the statute is invalid to

extent because control over able waters rests with the federal nment.

e state attorneys pointed out fur- that before the State Executive cil can grant a permit, certain tions must be met, of which one at the applicant must show that taken from a stream in connec- with a project is to be returned e nearest practicable place with- being greatly diminished. This tion could not be met by the rative because the proposed proj- alls for diversion of water from Cedar River to the Mississippi

rming the cooperative's proposed ct as "practical and reasonably ate," the commission said in its on that if it dismissed the ap- ion on the basis of failure to com- with federal requirements, the co- tive could seek review of the ission's actions.

. . .

## arolinas branch AGC ges postwar planning

e Carolinas Branch of the Associ- General Contractors of America egun a series of advertisements in and South Carolina newspapers g that plans be begun immediately ublic and private postwar construc- The first appeared Jan. 25. Among things, it said: "Construction of nds, public, private, new and re- ling, can play a big part in furnish- ostwar employment both locally ationally.

e general contractor is ready to go rk. He has the skeleton organiza- he has the equipment, and he has now-how . . . all left over from do- e greatest war-construction job in y. But—before you start any con- ion, you must have working draw- —you must know where, when, how ow much.

lueprints and specifications must de ready now—so that at the right bids can be opened for construc- rojects and contractors can break d and employ workers."

e Carolinas branch is offering a manual for postwar construction ers.

. . .

## any irrigation jobs e being expedited

sident Roosevelt has approved re- g construction of the second divi- f the Bureau of Reclamation's Buf- Rapids irrigation project in Mon-


# WHEN REPAIR CREWS *Take Over*

They're doing a great job — those ground crews — repairing damaged planes and other fighting equipment at front line bases, and everywhere. For operating riveters and other repair and assembly equipment, air compressors are powered by sturdy, dependable air-cooled gasoline engines. One more front line duty for the hundreds of thousands of Briggs & Stratton engines now "In Service".

Just as Briggs & Stratton engines have been war-proved, so have our facilities for manufacture. The way those rugged, dependable engines have come through with flying colors is definite proof that Briggs & Stratton high standards of quality materials and precision manufacture could be, *and are being* maintained in face of wartime production schedules.

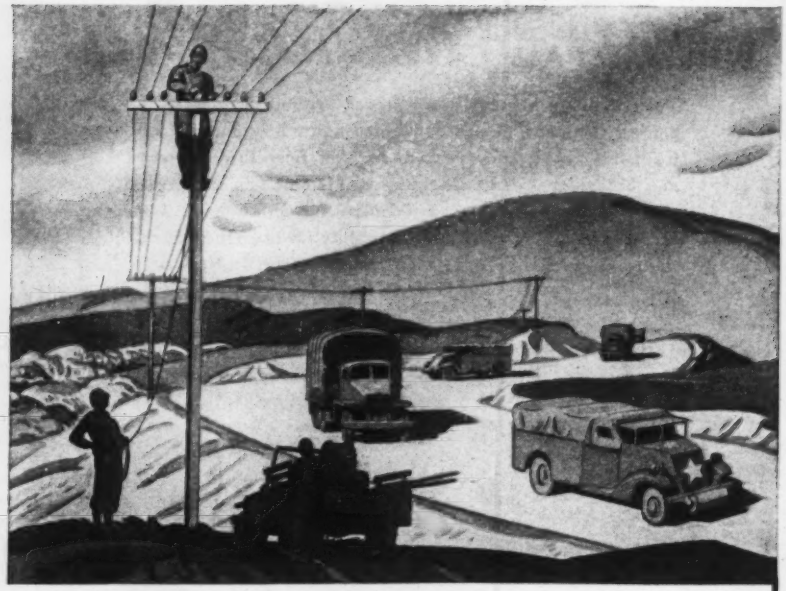
Our engineering and production staffs are geared up to help you on present war needs, or on your planning now for future production of gasoline powered equipment.

*"It's powered right — when it's powered by Briggs & Stratton."*

**BRIGGS & STRATTON CORP.**
MILWAUKEE 1, WISCONSIN, U.S.A.

BACK THE ATTACK
BUY WAR BONDS

4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES



# Treated wood moves up front with the U. S. Signal Corps

***WOLMANIZED* POLES*** and crossarms, used by the Signal Corps for "light-loading tactical" lines, are making an important contribution to this fight. The smooth-sawn 4x4's and 2x4's stow more compactly than round poles, take up less shipping space. Their salt treatment weighs much less than that usually used for poles—cuts shipping weight—and this treatment greatly reduces fire hazards.

***IN THE FIELD,*** this wood can be stored without fear of its being destroyed by termites and decay. Impregnation with Wolman Salts* preservative makes certain the wood is sound when it's needed. And, because Wolmanized wood is clean, these poles and crossarms are easy to handle, erect and climb.

***WOLMANIZED LUMBER*** is seeing service in many places around the world. Manufacturing plants in our own country are able to devote more attention to wartime production because their Wolmanized Lumber construction requires less attention. The same is true of the railroads' bridges, platforms and shipping docks. In far-flung combat zones, barracks, warehouses and other buildings have this same certain protection against termites and decay.

***THERE'S A LESSON*** here for designers of all kinds of structures. Wolmanized Lumber, at little additional first cost, gives long life to wood construction, reducing upkeep costs. All of the usual advantages of building with wood are retained. American Lumber & Treating Company, 1649 McCormick Bldg., Chicago 4, Illinois.

*Registered trade marks

WOOD THAT'S *Alloyed* FOR SAFETY AND ENDURANCE

AMERICAN LUMBER & TREATING COMPANY

tana, under the Water Conservation
Utilization Act amended last July
which UCU funds are now available
construction in lieu of labor contri
tions previously made by the now
funct work projects administration
the civilian conservation corps.

The Buffalo Rapids project, on
of which conscientious objector labo
being used, is the third of the bure
irrigation projects to receive nonre
bursable funds for labor to replace
by WPA and CCC, and is the fourth
use conscientious objector labor. Of
total cost of $1,628,000 for its sec
division, $706,000 will be available
WCU non-reimbursable funds. (
projects which have received such fu
and the amounts they received, a
Deerfield Unit of the Rapid Valley
gation project in South Dakota, $
000, and Newton irrigation pro
Cache County, Utah, $275,000.

Other projects using conscientious
jectors as labor include—Desch
projects in Oregon, which has been
approximately 150 such men on
earth fill dam, to clear the reservoir,
to build canals; Rapid Valley, S.
project, about 120 men; and Man
project in Colorado, approximately
men.

As to the Buffalo Rapids project,
gun in 1940, irrigation service
started this year for the first divis
The second division consists of th
units—Shirley, Terry and Fallon.
first is ready for service. The Terry
on which the conscientious objec
labor is being used, has the canal
tem completed, and the pumping pl
now being completed, with the expe
tion of beginning irrigation next y

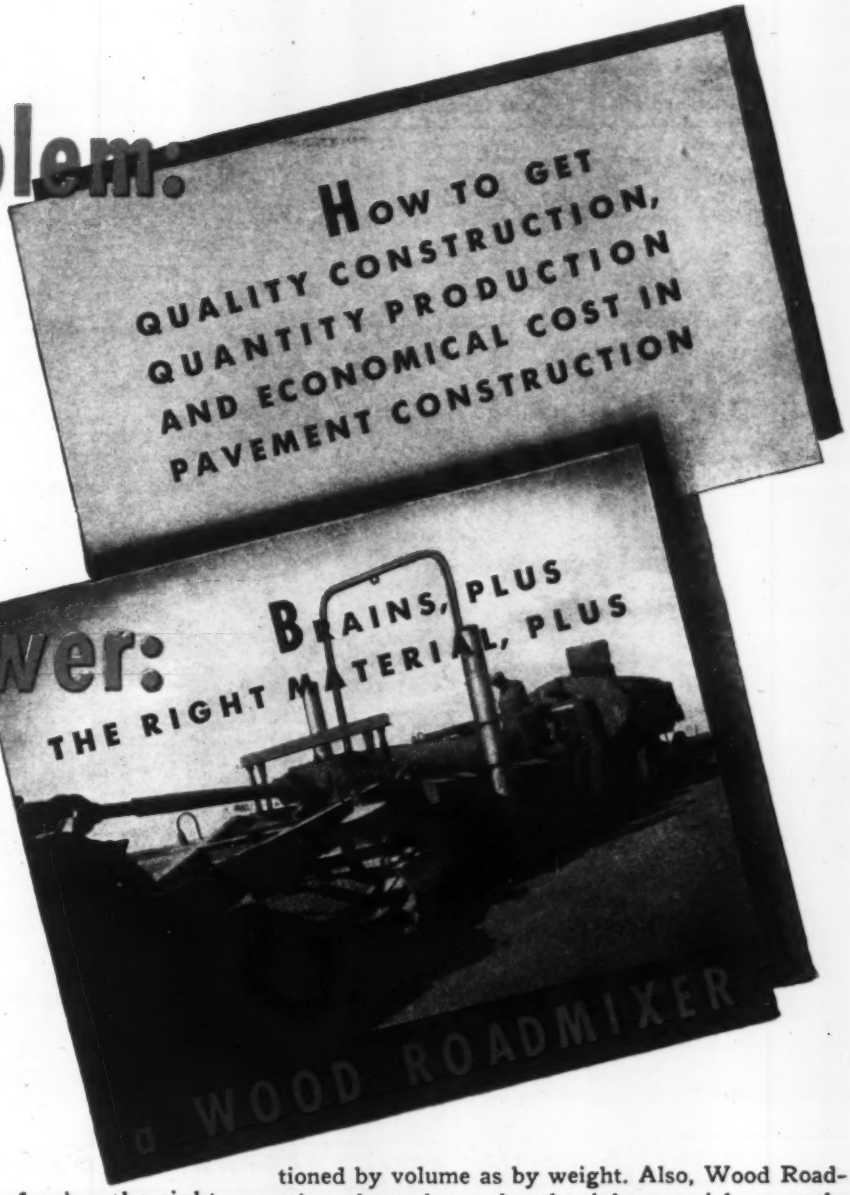
Major construction features for
Fallon unit will be a main pump
plant on the Yellowstone River, a re
pumping plant, a system of canals
laterals, and a short transmission l
Excavation for the main pumping pl
was about 10 percent finished when
war production board issued a st
construction order a year ago. Con
erable material had already been de
ered, and will now be available for
as soon as a priority rating is assig
by WPB. It is hoped to have the pro
ready for service by the spring of 19

• • •

## NW Div. Engineers unit to NW Service Comma

With the gradual change of the t
tical situation in Northwest Canada
the near completion of Army constr
tion in that area, the Northwest D
sion, Corps of Engineers, has been o
solidated with the Northwest Serv
Command, the War Department
announced.

# he Problem:




# he Answer:

OD paving is the result of using the right rials correctly mixed and properly proportioned. t constitutes right materials, correct proporng and proper mixing is simply a matter of cising common sense.

instance, Wood Roadmixers have built over one dred million square yards of pavement in the ed States and abroad from native or local mate-. Imported materials were not to be had, so mon sense dictated the use of materials at or the site of the job.

d Roadmixers have proved that windrowed rials on the job can be as accurately proportioned by volume as by weight. Also, Wood Roadmixers have shown that the right materials correctly proportioned can be mixed with the proper amount of binder in *one pass* on the job.

The Wood Roadmixer has junked many old-fashioned ideas of pavement construction simply by permitting the use of common sense in the design, preparation and the finish of a job. The result has been the construction of hundreds of miles of highest quality paving for one-third the cost of other methods. The Wood Roadmixer is a complete traveling mixing plant, and is the pioneer and leading travel plant method of rapid, low cost, high quality pavement construction.

WRITE FOR BULLETIN AND PRICES

**WOOD ROADMIXER**

Wood Manufacturing Co. • 816 West 5th St., Los Angeles 13, California

# MATERIALS AND LABOR PRICES

***Market quotations on construction materials and wage rates reported monthly by ENR correspondents***

CONSTRUCTION MATERIAL prices and labor rates for March, as reported to *Engineering News-Record*, show only minor changes from the preceding month. Short-leaf yellow pine is $1.00 to $5.00 higher in Dallas. Douglas fir is up 50c. on 1-in. sizes, and up $1.50 on 2x8-in. boards in Minneapolis. New ceiling prices set for fir in Montreal increased from those previously quoted. Fir piling prices in New York shipping area increased and now at the ceiling established by the OPA.

Cleveland wage rates are up 2½c. for carpenters, and 12½c. per hour for all other skilled trades reported, except bricklayers. Common ... also climbed there. In Montreal all reported construction wages ... 6c. per hour. The cost of living bonus, which formerly had to be ... to these rates, is now included in the basic wages.

Roofing supplies are off in Boston, and paving brick is down $1 ... M in New York City. Cement, aggregates, ready-mixed concrete, ... steel products, structural clay building tile, brick and lime, ... various kinds of pipe reported are unchanged from the preceding ...

## CEMENT, AGGREGATES, READY-MIXED CONCRETE—F. O. B. CITY

| | PORTLAND CEMENT— Per bbl., C/L lots, bbl. for bags, cash dis. | | incl. 40c. per not deducted | SAND AND GRAVEL— Per ton, carload lots Gravel, | Gravel | | CRUSHED STONE Per ton, carload lots | | CRUSHED SLAG Per ton, carload lots, f.o.b. plant | | CONCRETE BLOCK CO... 8x8x16-in.; truckload del.; per block | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cloth *a* | Paper | Bulk | 1½ in. | ¾ in. | Sand | 1½ in. | ¾ in. | 1½ in. | ¾ in. | Sand-grav. | Lt. wgt. Agg. |
| Atlanta | $2.77 | $2.52 | $2.47 | $1.79 | $1.89 | $1.99 | $1.79 | $1.89 | $1.59 | $1.69 | $0.17 | .... |
| Baltimore | 2.33 | 2.08 | 1.88 | 1.75‡ | 1.75‡ | 1.25‡ | 1.75‡ | 1.75‡ | 1.75‡ | 1.75‡ | .125 | $0.125*w* |
| Birmingham | 2.50 | 2.25 | 2.10 | 1.75 | 1.75 | 1.50 | .85 | 1.00 | .90 | 1.15 | .1425 | .... |
| Boston | 2.75*b* | 2.40*b* | 2.30 | 1.40‡ | 1.40‡ | 1.00‡ | 1.40‡ | 1.40‡ | .... | .... | .13 | .15*w* |
| Chicago | 2.70 | 2.45 | 2.30 | 2.15‡*d* | 2.15‡*d* | 2.15‡*d* | 2.15‡*d* | 2.15‡*d* | 1.75‡ | 1.75‡ | .16 | .16*x* |
| Cincinnati | 2.31 | 2.06 | 1.81 | 1.20 | 1.20 | 1.10 | 1.80 | 1.80 | .... | .... | .12 | .15*w* |
| Cleveland | 2.39 | 2.14 | .... | 1.70*i* | 1.55*i* | 1.60*i* | 1.73*i* | 1.73*i* | 1.73*i* | 1.73*i* | .14 | .15 |
| Dallas | 2.52 | 2.27 | 2.07 | 1.50*p* | 1.70*p* | 1.10*p* | 1.69*p* | 1.79*p* | .... | .... | .15 | .... |
| Denver | 3.08 | 2.88 | 2.32 | 1.20 | 1.30 | 1.25 | 1.65 | 1.75 | 1.00 | 1.00 | .15 | .... |
| Detroit | 2.39 | 2.14 | 1.99 | 1.50 | 1.50 | 1.50 | 2.25 | 2.25 | 2.00‡ | 2.00‡ | .14 | .14*w* |
| Kansas City | 2.58 | 2.33 | 2.18 | 1.85 | 2.30 | 1.00 | 1.91 | 1.91 | .... | .... | .125 | .125*cy* |
| Los Angeles | 3.00*v* | 2.40*v* | .... | 1.30 | 1.30 | 1.15 | 1.30*f* | 1.30*f* | .... | .... | .04½*bb* | .10*aa* |
| Minneapolis | 2.90 | 2.65 | .... | 1.00*h* | 1.00*h* | .25*h* | 1.00*h* | 1.00*h* | .... | .... | .12 | .15 |
| Montreal | .... | 1.95*rs* | 1.79*rs* | .... | 1.65‡*t* | 2.05‡*t* | 1.05*ct* | 1.15*ct* | .... | .... | .14*t* | .14*rt* |
| New Orleans | 2.41 | 2.16 | 1.96 | 1.65 | 1.65 | .90 | .... | .... | .... | .... | .19 | .... |
| New York | 2.69‡ | 2.44‡ | .... | 1.60*de* | 1.60*de* | .90*de* | 1.70*de* | 1.80*de* | .... | .... | .14*cc* | .14*rz* |
| Philadelphia | 2.33 | 2.08 | 1.88 | 1.55‡ | 1.65‡ | 1.20‡ | 1.90 | 1.95 | 1.10 | 1.10 | .155 | .155*w* |
| Pittsburgh | 2.45 | 2.20 | 2.00 | 1.65‡ | 1.65‡ | 1.85‡ | 2.25‡ | 2.25‡ | 1.50 | 1.50 | .17 | .17*x* |
| St. Louis | 2.80 | 2.52 | .... | 1.75‡ | 1.50‡ | 1 25/1.50‡ | 1.10*h* | 1.10*h* | .75*g* | .75*g* | .13 | .15*y* |
| San Francisco | ....*u* | 2.21 | 1.91 | 1.36 | 1.36 | 1.36 | 1.46 | 1.46 | .... | .... | .... | .20*aa* |
| Seattle | 2.95*o* | 2.75*o* | .... | 1.00*o* | 1.00*o* | 1.00*o* | 2.00*o* | 2.00*o* | .... | .... | .16 | .16*y* |

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount of 2 percent for cash in 10 days. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off. ... *r* 10c. per bbl. off, cash 20 days. *s* 8% sales tax included. ... not included. *u* Price withdrawn. *v* 20c. per bbl. discount; 20c. ... returnable cloth bag. *w* Cinder. *x* Waylite. *y* Haydite. ... *aa* Pumice. *bb* 4 x 8 x 12 in. *cc* Also 8 x 18 x 18 in.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer ... 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

### CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

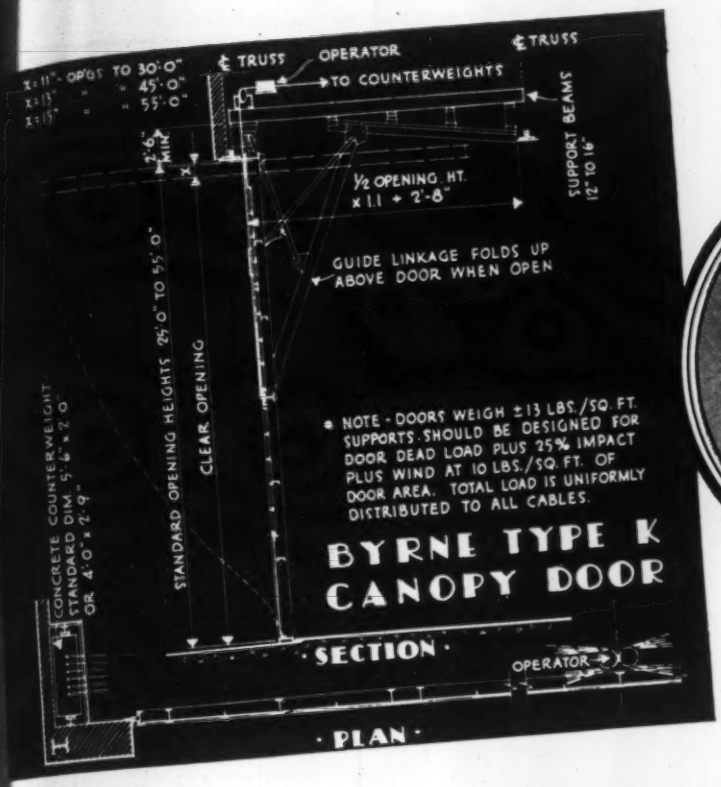
Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refund...

| | Bagged | Bulk | | Bagged | Bulk | | Bagged |
|---|---|---|---|---|---|---|---|
| Buffington, Ind | $1.70 | $1.65 | Ironton, Ohio | $1.60 | $1.55 | Richard City, Tenn | $1.80 |
| Dallas, Tex. (Inc. 9c. tax) | 1.84 | 1.79 | Limedale, Ind | 1.70 | 1.65 | Steelton, Minn | 1.80 |
| Hannibal, Mo | 1.70 | 1.65 | Norfolk, Va | 1.75 | 1.70 | Universal, Pa | 1.65 |
| Hudson, N. Y | 1.75 | 1.70 | Northampton, Pa | 1.55 | 1.50 | Waco, Tex. (Plus 9c. tax in Tex.) | 1.75 |
| Independence, Kans | 1.70 | 1.65 | North Birmingham, Ala | 1.70 | 1.65 | Montreal (8% sales tax incl.) | 1.68 |
| | | | | | | Discount 10c. per bbl. 20 days | |

## PAVING BRICK, BLOCK, ASPHALT, ROAD OILS—F. O. B. CITY

| | PAVING BRICK AND BLOCK Granite per M. lots of 50,000 | Brick per M 3x4x8½ in. | Wood per sq. yd. 3½ in. | PAVING ASPHALT Per ton, less than 80 penetration | | ASPHALT BINDERS—FLUXES Per gal., 80–300 penetration | | CUTBACK ASPHALT Per ton | | ROAD OIL Per gal. | ASPHALT EMULSION (Quick-break... Per ga... |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4x4x8 in. | carload lots | 16-lb. treat | Tank car | Drums | Tank car | Drums | Tank car | Drums | Tank car | Tank car |
| Atlanta | $73.00 | $39.35 | $2.25 | $18.53*e* | $24.62*e* | $0.0740*e* | $0.1309*e* | $0.0807*he* | $0.1348*h* | $0.0676*e* | $0.0826 |
| Baltimore | 150.00‡ | 48.00 | 80.00*m* | 15.00*r* | 21.00*r* | .06*r* | .09*r* | 13.00*r* | 23.00*r* | .065*r* | .07*r* |
| Birmingham | 150.00 | 48.00 | ..... | 17.95 | .....† | .0747 | .....† | .0834*h* | .....† | .065 | .09 |
| Boston | 80.00 | 57.00 | 3.75 | 14.20 | 20.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| Chicago | 150.00 | 55.00 | 1.80/2.00*d* | 14.00 | 22.50 | 13.00*g* | 21.50*g* | .0575*h* | .15*h* | .05*n* | .09/.10*n* |
| Cincinnati | 120.00 | 50.00 | ..... | 16.40 | ..... | .085 | ..... | 12.25 | ..... | .07 | .085 |
| Cleveland | 118.00 | 37.50 | 2.50 | 17.00 | 19.00 | .085 | .095 | .10*h* | .15 | .095 | .09 |
| Dallas | ..... | 36.00 | ..... | 13.65 | 20.30 | .06 | .11 | 16.00 | 24.80 | .06 | .05/.07 |
| Denver | ..... | 66.11 | ..... | 11.00 | ..... | 10.00 | ..... | .045*h* | ..... | ..... | ..... |
| Detroit | ..... | 37.50 | ..... | 18.06*f* | 25.60*f* | .0743 | .128 | .0718*h* | .119*h* | .067 | .0773 |
| Kansas City | ..... | 40.00 | ..... | 18.50 | 23.50 | .077 | .1075 | .077*h* | .107*h* | .057 | .11 |
| Los Angeles | ..... | 50.00 | ..... | 9.00*b* | 23.00 | 9.50*bg* | 24.00*bg* | 9.50*b* | ..... | .025 | .072 |
| Minneapolis | ..... | ..... | 2.30*d* | ..... | 27.70 | ..... | .126 | ..... | 32.64 | ..... | ..... |
| Montreal | 92.40 | ..... | ..... | 16.60*k* | 24.25*k* | .116*k* | .1485*k* | .115*hk* | .135*hk* | .08*k* | .135*k* |
| New Orleans | ..... | ..... | ..... | 13.50*a* | 20.00*a* | .057 | .088 | .06*h* | .095*h* | ..... | .080 |
| New York | ..... | 65.00 | ..... | 17.40 | 24.20*p* | 14.00 | ..... | .0725*h* | .1325*hp* | ..... | .0725*p* |
| Philadelphia | 140.00 | 58.00 | 4.06 | 15.00*r* | ..... | 14.00*r* | ..... | .065*hr* | ..... | ..... | 14.00*qr* |
| Pittsburgh | 135.00 | 38.75 | ..... | 18.00 | 23.00 | .09 | .16 | 20.00 | 36.00 | .07 | .06 |
| St. Louis | ..... | 37.00 | ..... | 16.00 | 22.00 | 15.00*g* | 21.00*g* | .0575*h* | .1213*h* | .648 | .0525 |
| San Francisco | ..... | 40.00 | ..... | 10.90 | 21.15 | 10.90*g* | 18.00*gr* | 12.90 | 17.50*r* | 9.50*qr* | .0525 |
| Seattle | ..... | 60.00*e* | ..... | 10.90*i* | 23.40*i* | ..... | 20.40*pi* | 11.40*i* | ..... | ..... | .0525*i* |

‡ Delivered. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse. *c* 3½x4x8½ in. *d* 2½ in. 12-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3x3½x8½ in. *k* Tax included. ... thousand. † Available on priority only and quoted specially. *p* Sh... shipments except to armed forces. *r* February 1943 prices, none lat...


℄ TRUSS
OPERATOR
TO COUNTERWEIGHTS
℄ TRUSS
SUPPORT BEAMS 12" TO 16"
½ OPENING HT. x 1.1 + 2'-8"
GUIDE LINKAGE FOLDS UP ABOVE DOOR WHEN OPEN
2'-6" MIN.
STANDARD OPENING HEIGHTS 25'-0" TO 55'-0"
CLEAR OPENING
CONCRETE COUNTERWEIGHT STANDARD DIM. 5'-6" x 2'-0" OR 4'-0" x 2'-9"
* NOTE - DOORS WEIGH ±13 LBS./SQ. FT. SUPPORTS SHOULD BE DESIGNED FOR DOOR DEAD LOAD PLUS 25% IMPACT PLUS WIND AT 10 LBS./SQ. FT. OF DOOR AREA. TOTAL LOAD IS UNIFORMLY DISTRIBUTED TO ALL CABLES.
BYRNE TYPE K CANOPY DOOR
SECTION
OPERATOR
PLAN

**HEART of the Hangar is the DOOR!**

# hen public construction gets the "GO-AHEAD" will your hangar plans be ready?

"V"-day will bring pressure from many quarters for the release of post-war projects employing large numbers of men. Will you be ready with your plans for that new hangar? Because an important part of such plans will be the door . . . the heart of the hangar . . . you should start with the door. Byrne engineers will gladly cooperate with you in designing the most practical door.

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**YRNE DOORS FOR OPENINGS OF EVERY TYPE AND SIZE**

## IRON AND STEEL PRODUCTS—BASE MILL PRICES

| | STRUCT. SHAPES-PLATE | REINF. BARS ¼-in billet *b* | RIVETS ½-in. structural *d* | WIRE NAILS Base *d* | SHEET PILING Base | STEEL RAILS Per Gross Ton Standard | Light | Re-rolled | TRACK SUPPLIES Angle Bars | Std. Spikes *c* | Tie Plates *c* | Track Bolts |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Birmingham | $2.10 | $2.15 | $3.75 | $2.55 | ..... | $40.00 | $40.00 | $39.00 | $2.70 | $3.00 | $2.15 | $4.75 |
| Chicago | 2.10 | 2.15 | 3.75 | 2.55 | $2.40 | 40.00 | 40.00 | 39.00 | 2.70 | 3.00 | 2.15 | 4.75 |
| Pittsburgh | 2.10 | 2.15 | 3.75 | 2.55 | 2.40 | 40.00 | 40.00 | 39.00 | 2.70 | 3.00 | 2.15 | 4.75 |
| Buffalo | 2.10 | 2.15 | ..... | ..... | 2.40 | ..... | ..... | ..... | ..... | ..... | 2.15 | ..... |
| Cleveland | 2.10 | 2.15 | 3.75 | 2.55 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Youngstown | ..... | 2.15 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3.00 | ..... | ..... |
| Detroit | ..... | 2.27‡ | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Gulf ports | 2.47*a* | 2.52*a* | ..... | ..... | 2.85*a* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Pacific ports | 2.75*a* | 2.80*a* | ..... | 3.05 | 2.95*a* | ..... | ..... | ..... | ..... | ..... | 2.30 | ..... |

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone. Steelton, Pa., spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per

## IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

| | STRUCTURAL SHAPES Per 100 lb. base price | REINFORCING BARS* Per 100 lb., ¼ in., base price 15 tons or over *b* New billet | Rail steel | Add Switch | $/cwt. for Del. | EXPANDED METAL LATH Per 100 sq. yd., carload lots Std. diamond mesh, 3.4 lb | Std. ribbed 3.4 lb. | WELDED FABRIC REINFORCING— Per 100 sq.yd., carload lots 4x16 in., No. 5 & 10 wires | 4x12 in., No. 8 & 12 wires | 6x6 in. No. 6 & 6 wires Per sq. yd | SHEET PILING Per 100 lb. base price |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Atlanta | $2.34 | $2.40 | $2.40 | $.02½ | $.10 | $21.06 | $23.00 | $1.82 | $1.35 | $0.1719 | $3.00 |
| Baltimore | 3.70 | 2.90 | 2.75 | ..... | .10 | 22.50 | 24.50 | 1.70 | 1.27 | .1611 | 3.00 |
| Birmingham | 2.10*a* | 2.15 | 2.15 | .02½ | .10 | 19.00 | 21.00 | 1.80 | 1.34 | .1701 | ..... |
| Boston | 3.85 | 3.51 | 3.36 | $20 C.L | .10 | 18.50 | 29.50 | 1.76 | 1.31 | .1656 | 2.70 |
| Chicago | 2.10*a* | 2.15 | 2.15 | .03 | .05 | 21.50 | 23.50 | 1.67 | 1.25 | .1575 | 2.40 |
| Cincinnati | 3.68 | 2.53*cd* | 2.53*cd* | ..... | .05 | 19.50 | 21.50 | 1.66 | 1.25 | .1566 | ..... |
| Cleveland | 2.10*a* | 2.15 | 2.15 | .02½ | .10 | 19.50 | 21.00 | 1.66 | 1.25 | .1566 | ..... |
| Dallas | 4.25 | 3.17 | 3.17 | ..... | .... | 25.00 | 27.50 | 1.93 | 1.42 | .1827 | ..... |
| Denver | 4.57 | 4.842 | 3.85 | ..... | .... | 26.50 | 26.50 | 1.97 | 1.45 | .186 | ..... |
| Detroit | 3.65‡ | 2.52‡ | 2.52‡ | ..... | .10 | 30.00 | 30.00 | 1.68 | 1.26 | .1584 | 2.86 |
| Kansas City | 4.19 | 2.61*cd* | 2.61*cd* | .0 | .05 | 24.50 | 26.50 | 1.78 | 1.33 | .1683 | 2.874 |
| Los Angeles | 3.65*f* | 2.575 | 2.425 | .02½ | .05 | 23.00 | 27.50 | 1.93 | 1.42 | .1827 | 3.65 |
| Minneapolis | 3.81‡ | 2.73 | 2.73 | .0 | .10 | 25.00 | 27.00 | 1.80 | 1.34 | .1701 | 2.736 |
| Montreal | 4.00*i* | 2.90*i* | 2.80*i* | ..... | .... | 26.00*hij* | 33.00*hij* | 2.25*i* | 3.14*i* | .2281 | ..... |
| New Orleans | 4.229‡*k* | 2.52 | 2.52 | .05 | .10 | 19.00 | 21.00 | 1.82 | 1.35 | .1715 | 2.873 |
| New York | 3.75 | 2.76*c* | 2.76*c* | ..... | .15 | 17.50 | 19.50 | 1.76 | 1.32 | .1665 | 2.74 |
| Philadelphia | 3.66 | 3.82 | .... | ..... | .... | 19.50 | 21.50 | 1.71 | 1.28 | .1611 | 2.72 |
| Pittsburgh | 2.10*a* | 2.15 | 2.15 | .02½ | .10 | 23.00 | 26.50 | 1.59 | 1.20 | .1503 | 2.40 |
| St. Louis | 3.697 | 2.74 | 2.74 | .0 | .05 | 28.00 | 34.00 | 1.69 | 1.27 | .1602 | 2.70 |
| San Francisco | 4.35 | 2.825 | 2.675 | .02½ | .10 | 21.00 | 24.50 | 1.93 | 1.42 | .1827 | 3.85 |
| Seattle | 2.75*e* | 2.80*e* | .... | ..... | .... | 34.50 | 38.50 | 1.93 | 1.42 | .1827 | 2.95*f* |

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* Fa dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 25c.; 1 to 5 tons, add 10c. * High scrap steel prices cut former 15c. differences between ne billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax. *j* August 1942 price; not on market. *k* Quotation on changed basis; n actual price change.

## PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

| | C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a* | VITRIFIED SEWER PIPE Per foot, std. 8 in., s.s. | Delivered std. 12 in., s.s. | ASTM 24 in., | C13–35 36 in., | CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in. | 8 in. | CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in. | C 14–35 24 in. | WROUGHT STEEL PIPE Full standard weight, *h* 1 to 3 in., Butt Weld Black % | Galv. % | 3½ to 6 in.; Lap Weld Black % | Galv. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Atlanta | $49.66 | $0.265 | $0.468*bc* | $1.8525 | $4.68*c* | $85.00 | $128.00 | $0.45 | $1.642 | 48.2 | 54.2 | 59.7 | 51.2 |
| Baltimore | 53.00 | .35 | .60 | 2.65 | 7.25 | 160.00 | 200.00 | .50 | 1.75 | 65.5 | 57.5 | 63.0 | 54.5 |
| Birmingham | 45.00 | .275 | .495 | 1.95 | 5.50 | 100.00 | 220.00 | .50 | 1.70 | 62.2 | 54.2 | 59.7 | 51.2 |
| Boston | 55.40 | .26 | .463 | 2.07 | 5.85 | ..... | ..... | .60 | ..... | .... | .... | .... | .... |
| Chicago | 54.33 | .35 | .675 | 2.70 | 7.00 | 100.00‡ | 150.00‡ | .45 | 1.85 | 66.0 | 55.0 | 64.5 | 53.0 |
| Cincinnati | 53.27 | .231 | .4455 | 1.80 | 5.125 | 105.00 | 170.00 | .60 | 1.70 | 57.1 | 43.4 | 54.0 | 39.8 |
| Cleveland | 54.75 | .224*rs* | .432*rs* | 1.80*rs* | 5.125*rs* | 90.60 | 139.40 | .36 | 1.60 | 68.5 | 57.5 | 66.0 | 54.5 |
| Dallas | 56.43 | .31 | .58 | 2.25 | 5.00 | 90.00 | 110.00 | .46 | 1.57 | 59.9 | 51.9 | 57.3 | 48.3 |
| Denver | 61.56 | .29† | .52† | 2.16† | 3.00*n* | 125.00 | 200.00 | 1.00 | 2.22 | 58.4 | 50.4 | 55.7 | 47.2 |
| Detroit | 54.75 | .35 | .675 | 2.70 | 7.75 | 135.00 | 200.00 | .40 | 1.75 | 57.7 | 44.0 | 54.8 | 40.6 |
| Kansas City | 55.73 | .315 | .39 | 2.20 | 5.86 | 140.00 | 260.00 | .45 | 1.60 | 35.9 | 46.4 | 46.6 | 59.9 |
| Los Angeles | 68.40 | .282† | .508† | 2.034† | 5.085† | 115.50 | 192.50 | 1.00 | 2.00 | 61.1 | 50.1 | 58.6 | 47.1 |
| Minneapolis | 59.00 | .275† | .495† | 1.98† | 5.37† | ..... | ..... | .90 | 2.10 | 64.2 | 53.2 | 60.7 | 49.2 |
| Montreal | 67.00 | .85*o* | 1.50*o* | 5.25*p* | 8.50*ep* | 45.00*m* | 64.00*m* | .48*m*† | 1.92*m*† | .... | .... | .... | .... |
| New Orleans | 51.78 | .26 | .48 | 1.69 | ..... | 150.00 | 220.00 | .45 | 1.65 | 62.4 | 54.4 | 58.8 | 50.3 |
| New York | 52.40 | .308 | .594 | 2.52 | 6.45 | ..... | ..... | .60 | 1.40 | 64.9 | 53.9 | 62.4 | 50.9 |
| Philadelphia | 51.00 | .30 | .58 | 2.50 | 7.50 | 150.00 | 225.00 | .45 | 1.75 | 56.6 | 42.8 | 53.6 | 39.1 |
| Pittsburgh | 56.00 | .245† | .4725† | 1.845† | 5.4325 | 97.80 | 154.20 | .85*g* | 2.00*g* | 68.5*i* | 57.5*i* | 66.0*i* | 54.5*i* |
| St. Louis | 53.62 | .28 | .504 | 2.016 | 4.50 | 85.00 | 220.00 | 1.25*j* | 2.25*k* | 56.4 | 42.6 | 52.5 | 38.4 |
| San Francisco | 68.40 | .3625*d* | .6525*d* | 2.61 | 6.52 | 115.00 | 192.50 | .58 | 2.34 | 45.0 | 31.0 | 41.0 | 28.0 |
| Seattle | 70.20 | .375 | .675 | 2.70 | 6.75 | 84.00 | 187.50 | .51*f* | 1.44*f* | .... | .... | .... | ..... |

‡ Delivered. †F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N.J. (base) $49.00. Based on existing freight rates; subject to rate change. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¾ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. 3 percent tax on transporation costs not included. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points l on butt, 1½ on lap. Freight is figured from Pittsburgh, Lorain, O., Chica Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Di count for Pittsburgh base: Butt-weld—1 in. and 1¼ in. black 34, galv. 16; 1½ in. black 38, galv. 18½; 2 in. black 37½, galv. 18. Lapweld—2½ in. to 3½ black 31½, galv. 14½; 4½ in. to 8 in. black, 32½ galv. 17. *j* Reinforced; spec. C 76–37. *k* Reinforced; spec. C 75–37. *l* Plus sales tax. *m* Tax included *n* 27-in. pipe. *o* Less 50%. *p* Less 53%. *r* Truck delivery. *s* Also Jan. pri

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Ten years ago our scientists started working on a more effective way of restoring the masonry surfaces of concrete, stucco or brick buildings. Today America's buildings are able to profit from our long research. For we have created a coating which welds itself mechanically and chemically to exterior surfaces. It is called Waterfoil and is manufactured of irreversible inorganic gels. It forms a hard, heavy, fine textured surface coating from which water vapor may escape. Water absorption, however, is impeded, thus preventing serious reinforcing bar rust and spalling. Waterfoil contains only non-critical materials and is now available so that you can decorate and restore your disintegrating masonry walls and preserve your buildings for tomorrow. Any careful workman can apply Waterfoil. Send for the literature on Waterfoil now; all maintenance executives and property administrators should have it.

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THE UNIQUE TREATMENT FOR EXTERIOR MASONRY SURFACES

# LUMBER, TIMBER PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

| | SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) — All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics) | | | | | | | | LONG LEAF Y. P. Merchantable grade up to 20 ft. | | PLYWOOD Rail freight increm (See note for base pr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1x6 S4S | 1x8 S4S | 2x4 S4S | 2x6 S4S | 2x8 S4S | 2x10 S4S | 3x12 Rgh | 6x12 Rgh | 12x12 Rgh | 2x12 Rgh | 12x12 Rgh | ¼" |
| Atlanta | $37.00 | $37.00 | $32.00 | $31.00 | $31.00 | $34.50 | $46.00 | ..... | ..... | $54.00 | $64.00 | $17.90 |
| Baltimore | 42.00 | 45.00 | 42.00 | 42.00 | 43.00 | 48.00 | 65.00 | ..... | ..... | 115.00 | 120.00 | 18.25 |
| | *48.00* | *48.00* | *55.00* | *55.00* | *55.00* | *55.00* | *68.00* | *$70.00* | *$70.00* | ..... | ..... | ..... |
| Birmingham | 34.50 | 36.50 | 32.00 | 32.00 | 34.00 | 34.00 | 53.00 | 53.00 | 56.00 | ..... | ..... | 17.35 |
| | 37.50 | 37.50 | 37.00 | 37.00 | 37.00 | 43.00 | 65.00 | ..... | ..... | ..... | ..... | ..... |
| Boston ‡* | 42.00[j] | 45.00[j] | 55.00[j] | 60.00[j] | 60.00[j] | 65.00[j] | 68.00[j] | ..... | ..... | 72.00[j] | 72.00 | 18.25 |
| ‡* | *60.00* | *60.00* | *55.00* | *60.00* | *65.00* | *65.00* | *72.00* | *72.00* | *72.00* | ..... | ..... | ..... |
| Chicago | 50.00 | 51.00 | 50.00 | 49.00 | 50.00 | 54.00 | 67.00 | ..... | ..... | 80.00[l] | 95.00[l] | 14.60 |
| | *60.00* | *60.00* | *47.50* | *47.00* | *47.00* | *48.00* | *57.00* | *56.00* | *58.00* | ..... | ..... | ..... |
| Cincinnati | 47.50 | 49.00 | 42.50 | 42.50 | 42.50 | 44.50 | 67.00 | ..... | ..... | 65.00 | 65.00 | 17.35 |
| | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Cleveland | 42.50[k] | 42.50[k] | 52.50[k] | 51.00[k] | 65.00 | 65.00 | 83.00 | 83.00 | 83.00 | ..... | ..... | 17.75 |
| Dallas e | 45.25 | 45.25 | 44.50 | 43.00 | 43.00 | 47.25 | 60.75 | 58.75 | 58.75 | 88.50 | 85.00 | 14.60 |
| Denver ‡ | 64.00[i] | 62.00[i] | 65.00[i] | 65.00[i] | 65.00[i] | 66.00[i] | 69.00[i] | *83.00* | *89.00* | ..... | ..... | 10.45 |
| Detroit | 61.00 | 61.00 | 57.75 | 57.75 | 57.75 | 62.75 | 72.75 | 75.00 | 90.00 | 70.75 | 90.00 | 17.35 |
| | *57.00* | *57.00* | *57.00* | *57.00* | *62.75* | *63.75* | *71.00* | *75.00* | *75.00* | ..... | ..... | ..... |
| Kansas City a | 64.00 | 64.00 | 62.00 | 60.50 | 62.00 | 64.00 | 79.00 | ..... | ..... | 79.00 | 89.00 | 12.60 |
| | *60.00* | *60.00* | *58.00* | *58.00* | *58.00* | *58.00* | *75.00* | *80.00* | *80.00* | ..... | ..... | ..... |
| Los Angeles a | *60.00* | *60.00* | *60.50* | *60.75* | *59.25* | *59.25* | *72.75* | *72.00* | *72.00* | ..... | ..... | 9.90[gh] |
| Minneapolis ‡b | 59.00[i] | 59.00[i] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 12.60 |
| ‡ | *56.50* | *56.50* | *55.75* | *56.00* | *55.00* | *56.25* | *63.25* | *62.00* | *62.00* | ..... | ..... | ..... |
| Montreal †f | *58.00* | *61.00* | *54.00* | *58.00* | *60.00* | *66.00* | ..... | ..... | ..... | 200.00 | 200.00 | ..... |
| | *54.00* | *54.00* | *57.00* | *57.00* | *57.00* | *58.75* | *62.00* | *62.00* | *62.00* | ..... | ..... | ..... |
| New Orleans | 37.50 | 37.50 | 32.50 | 31.50 | 31.50 | 35.00 | 46.00 | ..... | ..... | 52.50 | 69.00 | 14.60 |
| | *31.00* | *31.00* | *35.00* | *31.00* | *34.00* | *32.00* | *35.00* | ..... | ..... | ..... | ..... | ..... |
| New York | 62.50 | 62.50 | 57.50 | 57.50 | 57.50 | 59.00 | 74.00 | ..... | ..... | 120.00[f] | 125.00[f] | 18.35 |
| ‡ | ..... | ..... | *65.00[i]* | *65.00[i]* | *66.00[i]* | *65.00[i]* | [ Range from $75 to $95 ] | | | ..... | ..... | ..... |
| Philadelphia | 65.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 75.00 | ..... | ..... | 130.00 | 130.00 | 18.25 |
| | *70.00* | *75.00* | *70.00* | *70.00* | *70.00* | *70.00* | *85.00* | *90.00* | *90.00* | ..... | ..... | ..... |
| Pittsburgh | 50.80 | 53.20 | 62.75 | 55.00 | 60.85 | 62.50 | 76.25 | ..... | ..... | ..... | ..... | 18.10 |
| | *69.20* | *68.10* | *66.10* | *65.30* | *65.20* | *65.65* | *88.75* | *88.75* | *88.75* | ..... | ..... | ..... |
| St. Louis ‡c | 56.00 | 56.00 | 53.00 | 52.00 | 52.00 | 55.00 | 69.00 | 75.00 | 75.00 | 86.00 | 85.00 | 14.60 |
| San Francisco d | *36.50* | *36.50* | *36.50* | *36.75* | *34.75* | *34.75* | *38.50* | *38.00* | *38.00* | ..... | ..... | 7.30[g] |
| Seattle | *35.00* | *35.00* | *35.00* | *35.00* | *35.00* | *35.00* | *40.00* | *40.00* | *40.00* | ..... | ..... | 0.00 |

**Bold Face type, Southern Pine.** *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Spruce. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* F.o.b. cars San Francisco freight rate. *e* 10% discount taken off. *f* Up to 18 ft. † Plus sales tax. * Prices for truck delivery; no longer quoting carload lots f. o. b. city.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, ... 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. ... Seattle base price on ¼", $95.15; on ¾", $104.85; price includes oiling and ... ing charges. For other centers add rail freight increment from table or pr... sise. For resin dipped treatment, add $10.50 per M. *g* Lower rate by w... shipment. *h* 50,000 lb. minimum *i* Ranges from $65 to $69. *j* Average pr... *k* August 1943 price. *l* September price; none later available.

# GLASS, EXPLOSIVES, CHEMICALS

| | WINDOW GLASS — Discounts from jobbers list, Aug. 15, 1938 — Single or Double Thickness A quality | B quality | EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots* |
|---|---|---|---|
| Atlanta | 75% | 75% | $0.15 |
| Baltimore | 78% | 79% | .15 |
| Birmingham | 76% | 76% | .105 |
| Boston | 77% | 78% | .15 |
| Chicago | 77% | 77% | .15 |
| Cincinnati | 77-10% | 77-10% | .15 |
| Cleveland | 77-10% | 77-10% | .19 |
| Dallas | 76% | 76% | .1625 |
| Denver | 76% | 76% | .155*e* |
| Detroit | 77% | 77% | .1575 |
| Kansas City | 77-10% | 77-10% | .155 |
| Los Angeles | 86%*d* | 88%*d* | .1575 |
| Minneapolis | 77% | 77% | .155 |
| Montreal | 40-10-5*ab* | 40-10-10*ac* | .1675† |
| New Orleans | 70% | 75% | .16 |
| New York | 81% | 82% | 22*f* |
| Philadelphia | 78% | 79% | .15 |
| Pittsburgh | 79% | 79% | 1225 |
| St. Louis | 77-10% | 77-10% | 155 |
| San Francisco | 66% | 73% | 155 |
| Seattle | 75% | 75% | .1575† |

Price of 60% Ammonia Gelatin in $0.01 per lb. higher than 40%

*a* Discount from list Sept. 1939; sales tax included, but 6% tax exemption not allowed for. *b* Single thickness. *c* Double thickness. *d* Discount from jobbers' list Sept. 15, 1928.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal St. add delivery charge of $6.00 per trip † F.o.b.

**40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)**

| | C/L 20,000 lb. net | Tons | 200 lb. lots |
|---|---|---|---|
| E. of the Miss., except Fla. and Me | $0.105 | $0.13 | $0.15 |
| W. of Miss. to Rocky Mtn. States, Fla. and Maine | .11 -.1175 | .135 -.1475 | .155 -.1675 |
| Rocky Mtn. States | .11 -.1225 | .135 -.1525‡ | .155 -.1725‡ |
| Pacific N. W. States | .1075-.12 | .1375-.15 | .1575-.17 |
| Pacific S. W. States | .1050-.1125 | .135 -.1425 | .155 -.1625 |

‡ F.o.b. Louviers, Colo., or Butte, Mont.

# PILES, TIES—F.O.B.

## PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir ... on Wash. and Ore. points to New York shipping area; pine based on freight ... Norfolk.

| Dimensions | Points | Length | By Rail — Pine | Fir |
|---|---|---|---|---|
| 12-in. at butt | 6-in. | 30 to 50-ft. | $0.33 | ... |
| 12-in.— 2-ft. from butt | 6-in. | 50 to 59-ft. | .34 | ... |
| 12-in.— 2-ft. from butt | 6-in. | 60 to 69-ft. | .35 | ... |
| 12-in.— 2-ft. from butt | 6-in. | 90 to 100-ft. | .... | .53 |
| 13-in.— 3-ft. from butt | 5-in. | 91 to 100-ft. | .... | .55 |
| 14-in.— 2-ft. from butt | 6-in. | 50 to 69-ft. | .40 | .42 |
| 14-in.— 2-ft. from butt | 6-in. | 70 to 79-ft. | .41 | .50 |
| 14-in.— 2-ft. from butt | 5-in. | 80 to 85-ft. | .52 | ... |
| 14-in.— 2-ft. from butt | 5-in. | 85 to 89-ft. | .55 | ... |
| 14-in.— 2-ft. from butt | 5-in. | 90 to 100-ft. | .... | .62 |

## RAILWAY TIES

| Prices f.o.b., per tie for carload lots: | | 6"x8"x8' Untr. | 6"x8"x8' Tr. | 7"x9"x8' Untr. | 7"x9"x8' Tr. |
|---|---|---|---|---|---|
| Boston | Oak | $1.50 | .... | $2.00 | ... |
| | Pine | 2.00 | $3.00*a* | 2.50 | $3.50 |
| New York | S. L. Sap Pine | 1.43/1.54 | 2.59 | 1.76 | 2.86 |
| | Mixed Oak | 1.71 | 2.59 | 2.42 | 3.58 |
| Birmingham | White Oak | 1.00 | 1.60*a* | 1.30 | 2.25 |
| Chicago | Red Oak | .. | 2.19*a* | 2.87 | 3.00 |
| Los Angeles | Douglas Fir | 1.10*h* | 1.75a*h* | 1.60*h* | 2.50 |
| Philadelphia | Red Oak | .... | 2.10*aa* | .... | 3.25 |
| St. Louis | White Oak | 1.48 | .... | 2.04 | .... |
| | Red Oak | 1.48 | 2.05*a* | 2.04 | 2.85 |
| | Sap Pine or Cypress | 1.55 | .... | 1.91 | ... |
| San Francisco | Douglas Fir | 1.25*bef* | .... | .... | 3.00 |
| Montreal | Birch or Maple | .85 | .95 | ....† | ...† |

Tr.— Treated; Untr.— Untreated. *a* Creosoted *b* 6"x8"x8'6". *c* Zinc. *d* Green. *e* F.o.b. cars. † Out of market. *g* January 1943 ... none later available. *h* Jan. '44 prices; ties not now available.

## CHEMICALS

**Water, sewage treatment, road work, f.o.b. carlots, New York**

| | |
|---|---|
| Bleaching powder, in drums, f.o.b. works, per 100-lb | $2.50- |
| Chlorine cylinders, liquid, per lb. delivered | |
| Calcium chloride, 77-80%, flaked, 100-lb. paper bag, del'd. ton | 18.50-2 |
| Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb | |
| Soda ash, 58%, in paper bags, per 100 lb. dense | |
| Sulphate of aluminum, commercial, in 100-lb. bags, per ton | 23.00-25 |
| Sulphate of copper, in bbl., per 100-lb | |

# HEAT
## CLINIC IN ACTION!

**....THESE MEN ARE DECIDING OW MUCH — FROM HOW LITTLE**

THE engineers shown above are carrying on exacting tests to see how much usable heat they can squeeze from the least amount of fuel-oil—what's known in technical language as "efficiency."

The machine being tested is a Cleaver-Brooks steam generator, but all types of Cleaver-Brooks equipment are subjected to exhaustive analysis and test—in the laboratory and the field under actual "job" conditions.

Research is a constant activity at Cleaver-Brooks, recognizing that war's end will set in action a nation-wide job of road construction and rehabilitation.

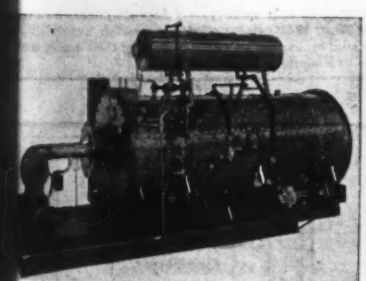
Time and cost-saving machines will enable you to handle more jobs with more profit. Be ready—be competitively equipped—to get your full share of the work.

Write today for full information on Cleaver-Brooks Tank Car Heaters and Bituminous Boosters. Get the complete facts on their high speed low cost performance—heating road oils and bituminous materials to application temperatures. Learn why the original and exclusive Cleaver-Brooks four-pass down-draft flue travel and integral burner construction, plus the positive dry-coil method of condensate return, provides unsurpassed speed and economy.

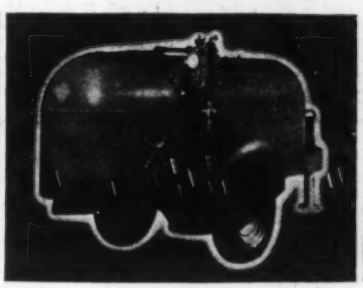
Cleaver-Brooks Tank Car Heaters are built in two and three tank car sizes—Portable Pumping Boosters in two capacity sizes, with truck mounting or 4-wheel trailer.

*Send for bulletins or see your Cleaver-Brooks distributor*

**CLEAVER - BROOKS COMPANY**
**5107 North 33rd Street • Milwaukee 9, Wisconsin**



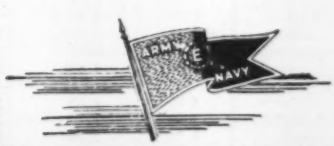
eaver-Brooks oil-fired automatic steam plants—ailable in 8 capacity sizes up to 100 H. P., rking pressures to 200 lbs. Requires only simple ld connections to place in operation.



Cleaver-Brooks Portable Tank Car Heater — a high pressure, oil-fired, compact mobile heater, available in two and three tank car sizes.

Truck-Mounted Cleaver-Brooks Portable Pumping Booster used in airport, flight strip, and road construction.

# Cleaver-Brooks




**TANK CAR HEATERS . . . BITUMINOUS BOOSTERS . . . AUTOMATIC STEAM PLANTS**

## STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

| | STRUCTURAL CLAY TILE—PARTITION—SCORED Per M. lots of 2,000 pieces or over, 3x12x12 in. | 4x12x12 in. | 8x12x12 in. | STRUCTURAL CLAY TILE—LOAD BEARING—SCORED Per M. lots of 2,000 pieces or over, 8x12x12 in. | 10x12x12 in. | 12x12x12 in. | BRICK Per M. in quantity. Common backing | Straight hard | LIME Per ton, Hydrated finishing | In barrels, Common hydrated | Carload, Pulverized or lump |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Atlanta | $104.00 | $114.00 | $199.00 | $234.00 | $244.00 | $280.00 | $13.50 | $18.04 | $26.54 | $15.04 | $15.04 |
| Baltimore | 84.00 | 90.00 | 170.00 | 200.00 | 260.00 | 320.00 | 15.90k | 19.00k | 18.00 | 13.00 | 2.90 |
| Birmingham | 80.00 | 85.00 | 160.00 | 191.00 | 252.00 | 288.00 | 14.50 | 17.00 | 18.11 | 13.64 | 2.25 |
| Boston | 89.35a | 93.30a | 178.70a | 202.50 | 271.80 | 308.70 | 16.50i | 19.50i | 17.50† | 12.50† | 14.00 |
| Chicago | 72.00 | 77.00 | 145.00 | 197.00 | 243.00 | 278.00 | 12.50 | 13.50 | 17.00 | 15.00 | 12.00 |
| Cincinnati | 65.55 | 69.90 | 131.20 | 148.70 | 210.35 | 240.45 | 22.00 | 22.00 | 15.50 | 13.00 | ..... |
| Cleveland | 60.00 | 64.00 | 120.00 | 144.00 | 193.00 | 221.00 | 17.00 | 17.00 | 15.75f | 13.25f | 3.50 |
| Dallas | 62.50 | 67.50 | 135.00 | 162.00 | 212.50 | 263.00 | 13.50i | 15.00i | 19.00 | 15.00 | 15.00 |
| Denver | 84.80 | 95.40 | 153.70 | 178.20 | 212.00 | 227.90 | 14.50 | 18.00 | 25.00j | 17.00f | 20.00 |
| Detroit | 86.05x | 91.80x | 172.10x | 213.00x | 268.00x | 311.60x | 20.00 | 21.00 | 18.00 | 16.00 | 18.00 |
| Kansas City | 67.00 | 69.00 | 89.00c | 128.00 | 163.00 | 189.00 | 14.50 | 16.50 | 19.32 | 13.00 | 10.00 |
| Los Angeles | 73.50†r | 89.50†r | 128.00c†r | 210.00†r | 368.00†r | 460.00†r | 13.50 | 15.00 | 16.50 | 17.50 | 17.50 |
| Minneapolis | 81.95b | 87.40b | 148.70b | ..... | 179.30b | 249.35b | 13.60 | 15.60g | 21.00 | 16.00 | 19.00 |
| Montreal | 94.55a | 100.45a | 199.50a | 160.45a | 109.40at | 137.40ax | 21.08†u | 28.35†u | 24.60u | 18.00u | ..... |
| New Orleans | 72.00 | 72.00 | 135.00 | 162.00 | 210.00 | 260.00 | 14.00 | ..... | 18.30 | 12.08 | 14.30 |
| New York | 78.40 | 83.60 | 115.00c | 193.30h | 238.80h | 295.60h | 16.50/17.50 | ..... | 20.00 | 14.00 | 17.00 |
| Philadelphia | 85.30 | 91.00 | 170.50 | 204.60 | 252.00 | 312.00 | 17.00 | 20.00 | 19.00 | 16.00 | 15.00 |
| Pittsburgh | 62.35 | 66.55 | 124.75 | 140.25 | 173.25 | 198.00 | 17.50 | 19.50 | 17.90 | 15.40 | 2.50 |
| St. Louis | 67.00 | 95.00 | 130.00 | 190.00 | 244.00 | 290.00 | 18.00 | 17.00 | 22.00 | 18.00 | 2.80 |
| San Francisco | 96.00 | 108.00 | 144.00 | ..... | ..... | ..... | 19.00 | ..... | 24.00 | 23.00 | 2.80 |
| Seattle | 115.00 | 125.00 | 230.00 | ..... | ..... | ..... | 20.00/ | 21.00/ | 20.00s | 20.00s | 20.00 |

† F.o.b. a Smooth. b Carload lots delivered to job. c 6x12x12 in. d Not load bearing. e 48 lb. tile. f Less $1.00, ½ cash 15 days, balance 30 days g Selected common. h F.o.b. Perth Amboy, N. J. i F.o.b. Warehouse only. j LCL k $1.00 discount if paid in 10 days. l Lump. m Per bbl., 180 lb. n Per bbl., 200 lb. p 280 lb. bag. r 5% discount 10 days. s 2% discount cash. t 5½x8x12. u 8% sales tax included. v 6x12x12-in. w Per 200 lb. x Prices also apply for Dec. and Jan.; market in Detroit unsettled; Tile scarce.

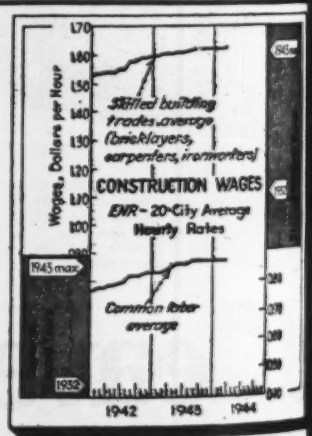
## PAINT, ROOFING—F.O.B. CARLOAD LOTS

| | RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry a | WHITE LEAD Per 100 lb. in oil | READY-MIXED PAINT Per gal., drums Graphite b | Aluminum b | Ferric Oxide d | ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85–90 lb. per sq. | Asphalt felt, per 100 lb. | Tar felt, per 100 lb. | Asphalt coating per gal. | Tar pitch, 350 lb. per ton |
|---|---|---|---|---|---|---|---|---|---|---|
| Atlanta | $10.25 | $14.125 | $1.30 | $2.25 | $1.20 | $1.90 | $1.61 | $1.61 | $0.27 | $29.00 |
| Baltimore | 10.00 | 13.75 | 2.00 | 3.00 | 2.50 | 2.30 | 2.70 | 2.70 | .40 | 29.00 |
| Birmingham | 10.25 | 14.125 | 2.35 | 3.50r | 1.98r | 2.04 | 1.97 | 1.97 | .32 | 28.35 |
| Boston | 10.00 | 13.75 | 1.65 | .... | 2.30 | 2.05‡ | 1.60A‡ | 1.60A‡ | .50‡ | 21.00 |
| Chicago | 10.00 | 13.75 | .... | .... | .... | 1.75A/ | 1.74A/ | 1.82A/ | .33/ | 23.00 |
| Cincinnati | 10.00 | 13.75 | 1.70 | 2.90 | 1.60 | 2.40 | 2.39A | 2.39A | .36 | 21.00 |
| Cleveland | 10.00 | 13.75 | 1.70 | 2.90 | 1.60 | 1.93 | 1.83A | 1.83A | .35 | 29.00 |
| Dallas | 10.00 | 14.50 | 1.88 | 2.11n | .05l | 1.75A | 1.66A | 1.66A | .35 | 30.00 |
| Denver | 10.50 | 14.25 | .... | 14.25k | .27l | 2.45 | 2.95 | 2.95 | .35 | 28.00 |
| Detroit | 10.00 | 13.75 | 1.75 | 3.00 | 1.60 | 2.25 | 2.25 | 2.25 | .50 | 23.00 |
| Kansas City | 10.00 | 13.875 | 2.30g | 2.55gr | 2.16g | 2.10 | 2.30 | 2.30 | .28 | 27.50 |
| Los Angeles | 10.25 | 14.25 | 1.60 | 2.25 | 2.30 | 2.10 | 1.50 | .... | .45 | ..... |
| Minneapolis | 10.00 | 13.875 | .... | .... | .... | 1.75i | 1.66Ai | 1.66Ai | .32 | 23.00 |
| Montreal | 9.25 | 6.25 | 2.50p | 4.90p | 3.15p | .... | .... | .... | .89 | 2.10 |
| New York | 10.00 | 13.75* | 2.03 | ....r | 1.64 | 1.66 | 1.58A | 1.58A | .26 | 25.00 |
| Philadelphia | 10.00 | 13.75 | 1.60/1.80 | 2.20r | 1.55 | 1.75 | 1.66 | 1.66 | .32 | 23.00 |
| Pittsburgh | 10.00 | 13.75 | 1.05 | 1.95 | .80 | 1.95 | 1.94A | 1.94A | .34 | 26.00 |
| St. Louis | 10.00 | 13.75 | 2.28s | 2.89r | 1.96s | 1.66 | 1.66 | 1.66 | .28 | 23.00 |
| San Francisco | 10.25 | 14.00 | 1.80 | 2.75n | 1.35 | 1.71 | 2.40 | 2.40 | .33 | 30.00 |
| Seattle | 10.25 | 14.25 | 1.90 | 3.00 | .... | 2.15 | 2.16A | .... | .35 | 28.50 |

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. a Red lead prices change frequently due to pig lead price charges. b U. S. War Dept. Spec. 3-49A. c ASTM Spec. D266-31. d 80% minimum ferric oxide. e Subject to 25% discount. f Distributors' price to contractors. g 5 gal. can. h Per roll, 65 lb. i Minneapolis and vicinity. j Asphalt pitch. k Per 100 lb. l Per lb. m Per bbl. n May, 1941 price, no later quotation available. p Less 8% sales tax. r Not available, except on priority rating; then quoted specially. s December, 1942 price. t Federal tax included.

## SKILLED AND COMMON WAGE RATES—PER HOUR

| | Bricklayers | Carpenters | Struct. Iron Workers | Hoisting Engineers | Plasterers | Common Labor Building | Common Labor Heavy Const. |
|---|---|---|---|---|---|---|---|
| Atlanta | $1.50 | $1.25 | $1.50 | $1.25 | $1.50 | $0.40 | $0.50 |
| Baltimore | 1.75 | 1.375 | 1.80 | 1.625/1.80 | 1.50 | .75 | .75 |
| Birmingham | 1.75 | 1.25 | 1.50 | 1.25/1.50 | 1.50 | .65 | .65 |
| Boston | 1.625 | 1.50 | 1.65 | 1.875 | 1.667 | .80/1.00 | .80/1.00 |
| Chicago | 1.75 | 1.70 | 1.76 | 1.75 | 1.825 | 1.10 | 1.10 |
| Cincinnati | 1.75 | 1.50 | 1.675 | 1.45/1.60 | 1.625 | .85 | .85 |
| Cleveland | 1.875c | 1.575 | 1.875 | 1.875 | 1.875 | 1.085 | 1.15/1.25 |
| Dallas | 1.625 | 1.25 | 1.50 | 1.75 | 1.625 | .60 | .75/1.25 |
| Denver | 1.65b | 1.50b | 1.50b | 1.50/1.625b | 1.65b | .80b | .80b |
| Detroit | 1.675 | 1.50 | 1.75 | 1.625/1.75 | 1.675 | .90 | .90 |
| Kansas City | 1.65 | 1.50 | 1.625 | 1.625 | 1.65 | .90 | .90 |
| Los Angeles | 1.50 | 1.35 | 1.625 | 1.375 | 1.667 | .875 | .875 |
| Minneapolis | 1.50 | 1.375 | 1.50 | 1.40 | 1.50e | .925 | .925 |
| New Orleans | 1.50 | 1.25 | 1.50 | 1.50 | 1.375 | .65 | .75 |
| New York | 2.00b | 1.85b | 2.00 | 2.00b | 2.00b | 1.031 | .95 |
| Philadelphia | 1.90 | 1.50 | 1.90 | 2.00 | 2.00 | .825 | .825 |
| Pittsburgh | 1.90 | 1.75 | 1.75 | 1.8125 | 1.875 | .90 | .80 |
| St. Louis | 1.75 | 1.50 | 1.75 | 2.00 | 1.75 | .95 | .95 |
| San Francisco | 1.875 | 1.50 | 1.75 | 1.50/1.75 | 1.75 | .95 | .95 |
| Seattle | 1.78 | 1.48 | 1.68 | 2.00 | 1.78 | 1.08 | 1.10 |
| Montreal* | .98 | .87 | .96 | .82 | .96 | .52 | .59 |




b 7 hr. day. c Prevailing rate on government work. e 35 hr. wk. * Cost of living bonus now included in basic wage.

**ENR Skilled Average:** (Bricklayers, Carpenters, Ironworkers) $1.8
**ENR Common Average:** $0.870.

# *New Slide Rules* IN PRODUCTION

POST
DRAFTING MATERIALS

## *3 Types ★ 3 Prices ★ Immediate Delivery*

### SIMPLE INSTRUCTION MANUALS INCLUDED

Made for the emergency—they'll do the job—and you can get 'em right now. Post Slide Rules come in leatherette cases and are accompanied by comprehensible instruction manuals. Read the descriptions below and reach for the phone for fast-action delivery.

1452-D Ten inch Celluloid Face bevel edge slide rule. Inches and metric rules on bevel edges. Scales A, B, C1, C, D and K on slide front. Scales S, L and T on reverse side.
Attractive leatherette case.....List Price $3.50

1444-D Five inch Celluloid Face POCKET style slide rule. Scales A, B, C1, C, D and K on slide front. Scales S, L and T on reverse.
Leatherette Pocket case.....List Price $2.25

1446-D Ten Inch Printed Surface slide rule. Inches and metric rules on vertical sides. Scales A, B, C1, C, D and K on slide front. Scales S, L and T on reverse side. Leatherette case.....List Price $1.50

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| Chicago | KEY. 7000 | New York | WIS. 7-7678 |
| Cincinnati | MAIN 2664 | Oklahoma City | 3-6306 |
| Cleveland | CHE. 7347 | Omaha | ATLANTIC 7890 |
| Columbus | MAIN 3420 | Philadelphia | LOM. 7044 |
| Dallas | RIVERSIDE 4403 | Pittsburgh | ATL. 3350 |
| Dayton | ADAMS 9174 | Portland | ATWATER 8681 |
| Denver | MAIN 5161 | St. Louis | CHESTNUT 0688 |
| Detroit | RAN. 8483 | Salt Lake City | 4-7823 |
| Ft. Wayne | ANTY 4142 | San Diego | FRANKLIN 1344 |
| Fort Worth | 3-3244 | San Francisco | DOU. 5975 |
| Hollywd | GRANITE 4188 | Seattle | MAIN 4022 |
| Houston | CAPITOL 1233 | Tampa | M-8377 |
| Indianapolis | MKT. 4466 | Toledo | ADAMS 7224 |
| Jacksonville | 5-2166 | Tulsa | 3-0168 |
| Kans. City | VICTR 7881 | Washington | NATL. 4063 |
| Knoxville | 3-4944 | Wichita | 2-2722 |

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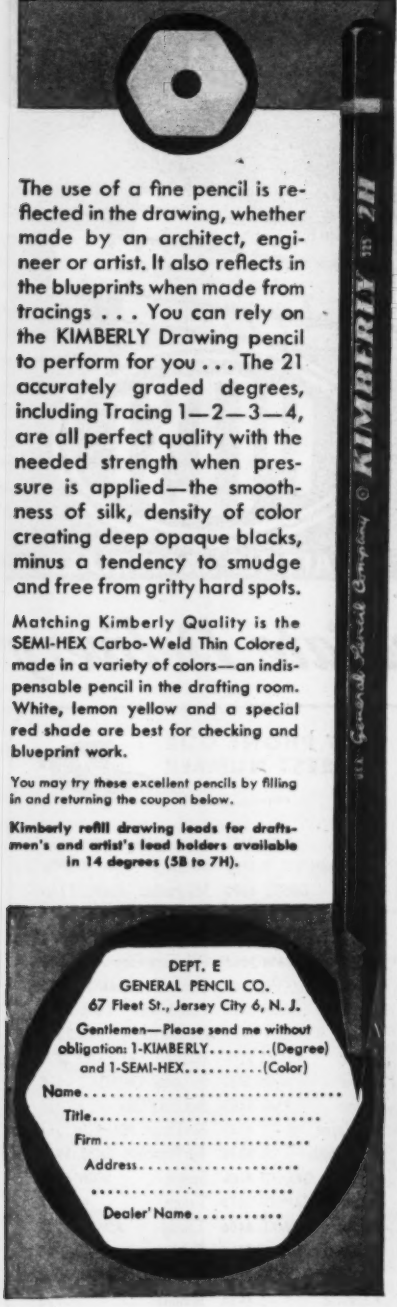
KIMBERLY
Quality
DRAWING PENCILS
WITH Carbo-weld LEAD




The use of a fine pencil is reflected in the drawing, whether made by an architect, engineer or artist. It also reflects in the blueprints when made from tracings . . . You can rely on the KIMBERLY Drawing pencil to perform for you . . . The 21 accurately graded degrees, including Tracing 1—2—3—4, are all perfect quality with the needed strength when pressure is applied—the smoothness of silk, density of color creating deep opaque blacks, minus a tendency to smudge and free from gritty hard spots.

Matching Kimberly Quality is the SEMI-HEX Carbo-Weld Thin Colored, made in a variety of colors—an indispensable pencil in the drafting room. White, lemon yellow and a special red shade are best for checking and blueprint work.

You may try these excellent pencils by filling in and returning the coupon below.

**Kimberly refill drawing leads for draftsmen's and artist's lead holders available in 14 degrees (5B to 7H).**

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Gentlemen—Please send me without obligation: 1-KIMBERLY.....(Degree) and 1-SEMI-HEX.....(Color)
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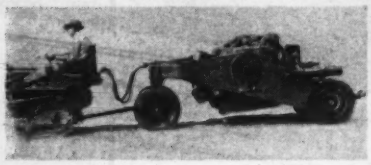
# NEW AIDS TO THE CONSTRUCTOR

## Small Scraper

Designed for loading into a transport plane or glider in wartime, it is expected that a new small scraper unit will have many peacetime uses. This scraper, of 1¾ cu. yd. struck capacity, or 2 yd. heaped capacity, is so constructed that the rear wheels can be located either inside or outside the width of the cut. In the latter position,



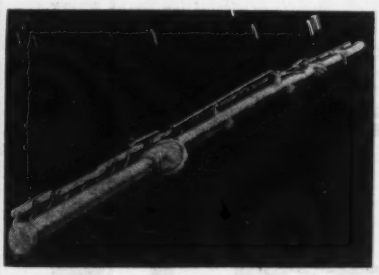
greater stability is provided for side sloping. The front-dump scraper can make a full 90-deg. turn or less within a circle diameter of 20 ft. without overturning, it is claimed.

Both the bowl and apron of this model are hydraulically operated. The hydraulic pump is driven by the tractor, while two double-acting jacks control the movement of the scraper bowl and apron. A three-position valve operates the cutting edge and regulates the cut from 0 to 6½ in. The scraper, 64 in. wide and 147 in. long, has a shipping weight of 2,520 lb.—*LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa.*

• • •

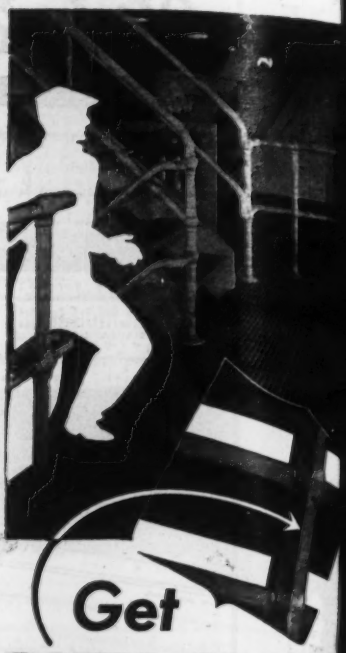
## Asphalt Spray Bars

Developed for application to any asphalt distributor, a new hot spray bar circulates bituminous material through an inner pipe running the full length of the bar. Fat and lean streaks are elimi-



nated, it is claimed, by scientific angle and spacing of orifices in nozzles; impact-proof swinging end sections, with patented unions, permit them to swing out of the way when an immovable obstruction is encountered.

The spray bar also has an instantane-



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See that scraper tread—and the crisp lines of the Hex cross bar? *That* gives a safer and cleaner tread and at the bottom of those cross bars you find clean, well-shaped fillets made by the metal displaced in the Bates patented process—no metal is lost. The weld is cleaner and stronger. The *floor* is cleaner and stronger. Yet, open steel flooring made under Bates patents costs no more.

*Write for copy of well-illustrated, 8½" x 11" CATALOG NO. 43-44. It gives complete data on fillet welded Open Steel Flooring and Stair Treads.*

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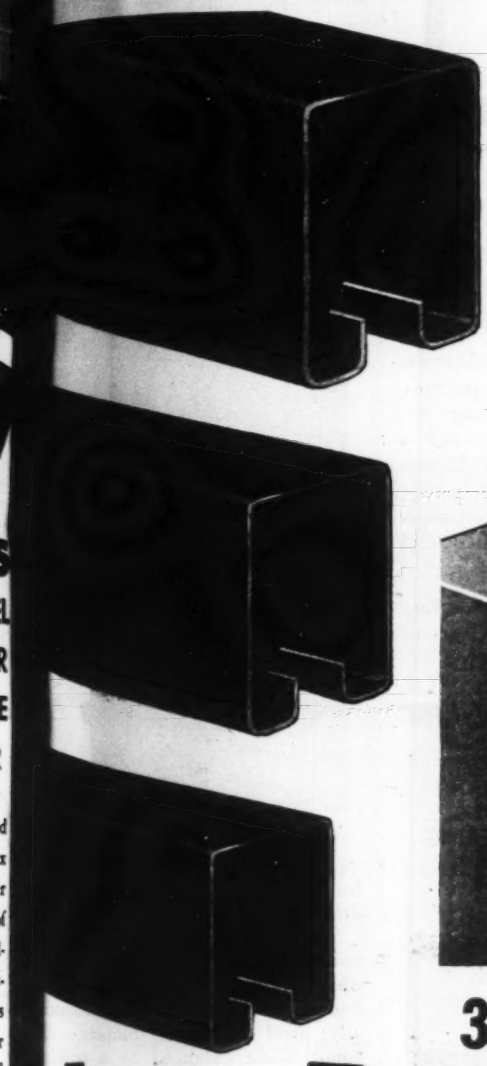
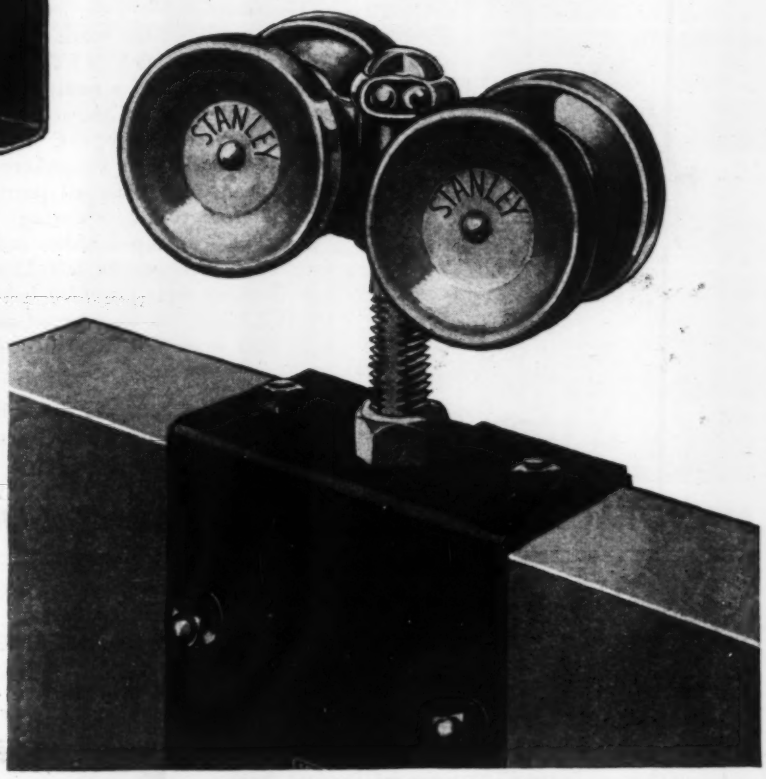
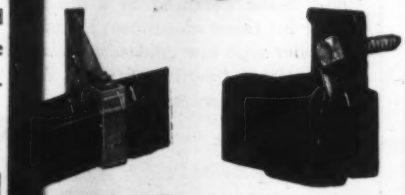
# STANLEY HARDWARE

## For Rolling or Sliding Doors





Stanley "Hold-Fast" Track Clamp No. X2651

Stanley Track Bracket No. X2650-C

Stanley Track becomes virtually a one-piece unit of any length when bound end-to-end with Stanley Track Brackets and Clamps.

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Three sizes, X (16 ga.), Y (14 ga.), and W (13 ga.), of Stanley No. 2641 Track and No. 2650 Hangers, will handle all common sliding doors weighing up to 350, 700 and 1000 pounds, respectively.

Stanley Hangers have accurate two-way adjusting nut, ball bearing swivels and roller bearing wheels.

Stanley Track carries the hangers *inside*, protected from weather and dirt. Straight pieces are made "straight as a die." Curved pieces are supplied with 90° turns, others on order. Send for catalog. The Stanley Works, New Britain, Connecticut.

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The photograph to the left shows various stages of the work of reintegrating with "GUNITE" the downstream face of a badly eroded concrete dam of the Central Hudson Gas and Electric Company, in central New York, near Poughkeepsie. Note cleaned and chipped portion, in the foreground, shooting the "GUNITE" at top middle and a finished section on the left. Drainage channels were provided behind the "GUNITE" to take care of seepage. This work was done by us in 1942.

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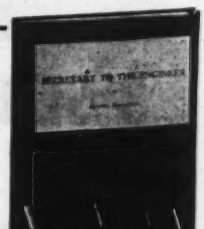

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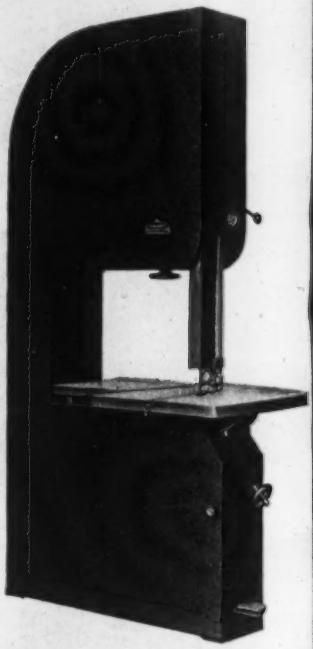
ous no-drip shutoff. Both ends of the bar can be raised for travel, without interfering with circulation.—*Cartwright Asphalt Equipment Co., Inc., Galion, Ohio.*

• • •

### Band Saw

Several modern practical features have been incorporated in a new 36-in. band saw, Model X40. The main frame is a one-piece cored casting, and the motor base is cast integral with the



frame. The saw is provided with direct drive 5 or 7½ hp. motors.

Some special features of the saw unit are: a conveniently located hand wheel to tilt the table, and a pointer to register the degree of tilt automatically; steel disc wheels running at 900 rpm.; blade balanced by a straining spring for shock absorption; ball bearing roller type saw guides; mechanical foot brake.—*American Saw Mill Machinery Co., Hackettstown, N. J.*

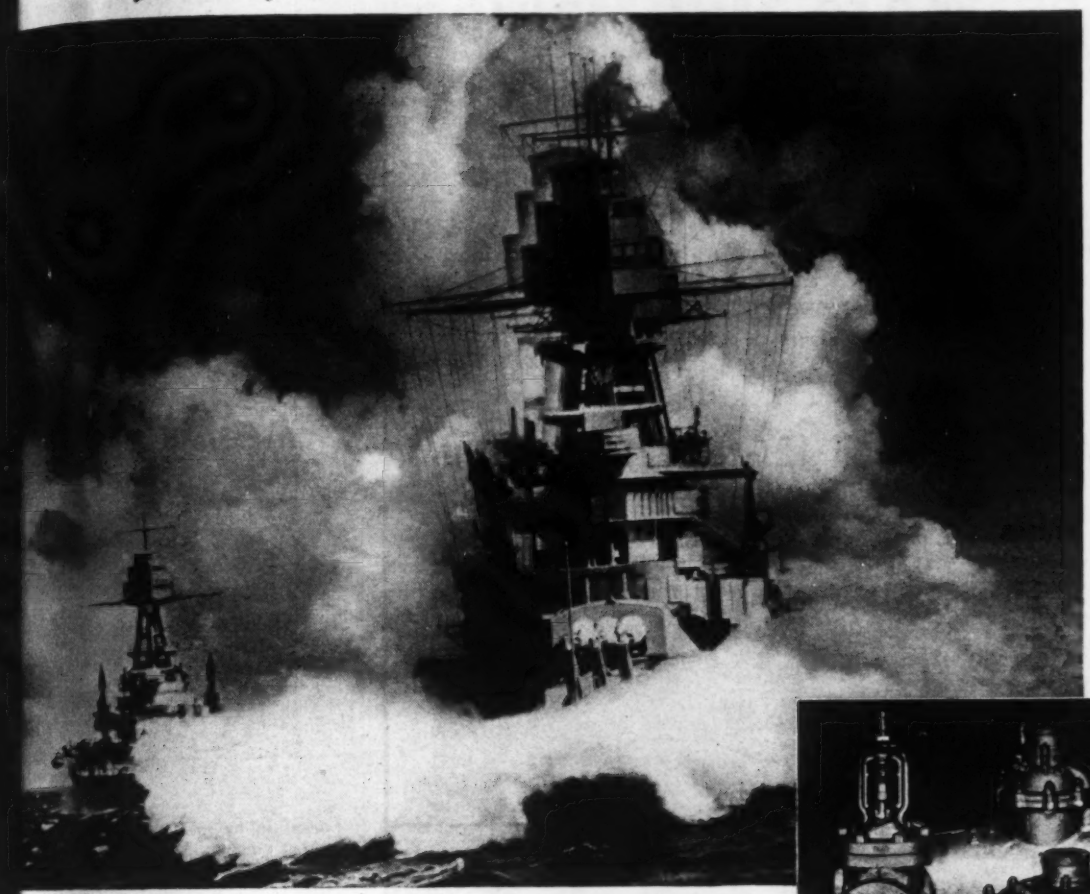
• • •

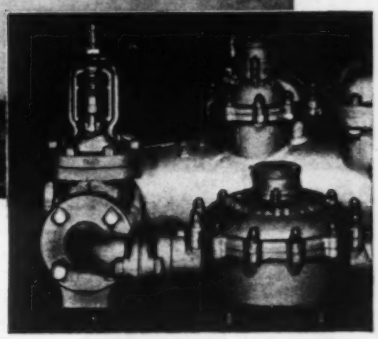
### Portable Elevator

Compact enough to be towed by a small towing car through a 6-ft. aisle and an 8-ft. door, a new portable hydraulic elevator may be operated wherever ordinary electric power is available. This unit, built to lift a 3,000 lb. load to a height of 30 ft., lifts at a rate of 20 ft. per second.

The elevator consists of a fabricated steel base carrying the hydraulic oil tank, motors and valves; outriggers for holding the unit stationary; telescoping hydraulic cylinders, and a 6x6-ft. work

*Making strong the things that make America strong*





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## Shaping a Valve's Future

THAT SHIP . . . defying a rough-and-tumble fighting ocean . . . needs stiff-willed stamina in the bolts and nuts that secure its ribs. .

That valve has a less harrowing experience with water. But it, too, needs bolts and nuts so clean and accurate that they respond to the inspector's wrench without profanity.

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1200' assembled pipe (132 Tons) were lowered to bed of Mississippi at St. Paul with 9—5-Ton Beebes, three lines to each hoist through blocks.

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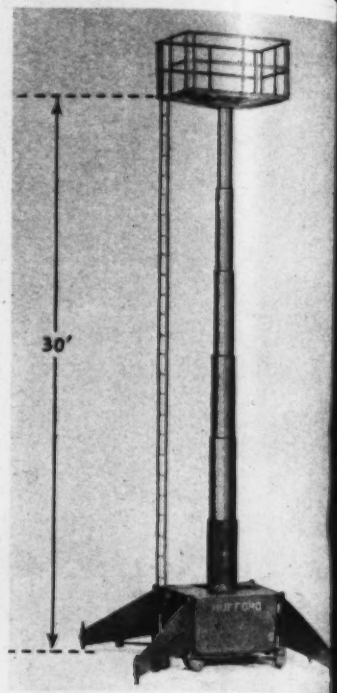
platform. The hydraulic cylinders are built with a high safety factor, and are so designed that the load may be off center at any time without affecting

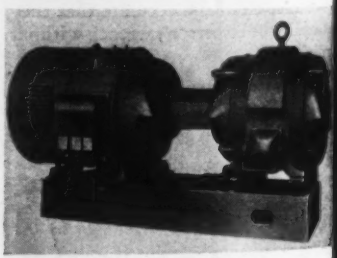



operation or safety. Operation is controlled by a 3-button switch on the platform. A telescoping ladder extends with the platform to full height.—*Hufford Machine Works, 315 Diamond St., Redondo Beach, Calif.*

• • •

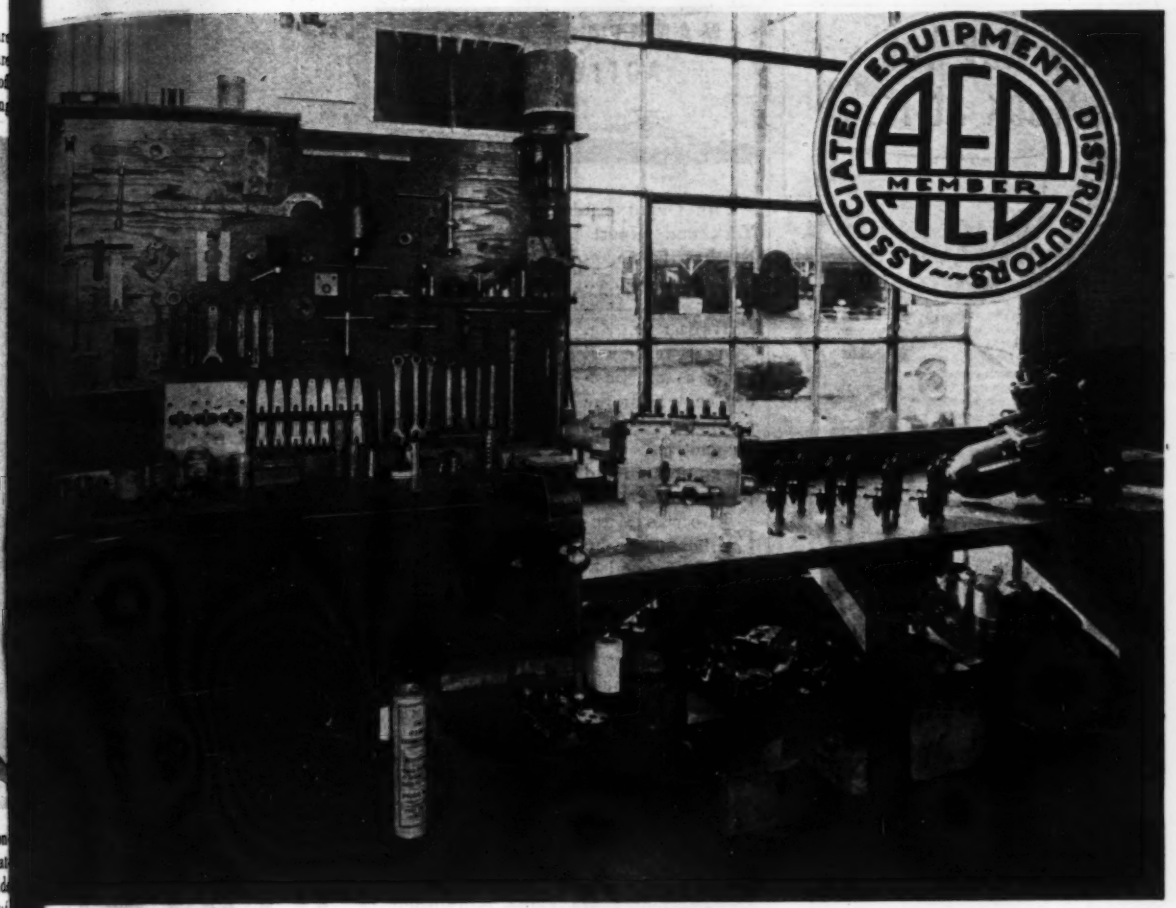
### Multiple-Man Welder

Capable of supplying welding power for 15 to 30 men at the same time, a new Century AC to DC motor generator set has been announced by the manufacturer. The squirrel cage induction motor is 160 hp., 440 volt, 60 cycle, 3 phase, 1,160 rpm., one hour 50 deg. C



temperature rise, with drip-proof construction. It drives a 70 volt, 1,500 amp. flat compounded, direct current generator.

These machines are capable of being operated in parallel, when large quantities of power are required.—*Century Electric Co., St. Louis 3, Mo.*

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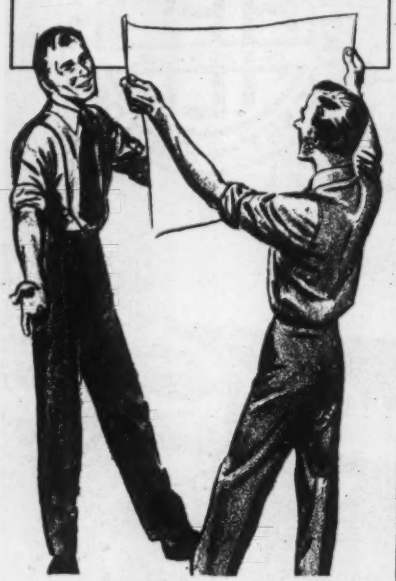

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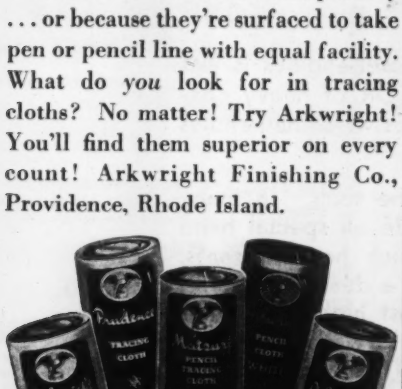


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## MANUFACTURERS' ACTIVITIES

THE OPENING of an enlarged New York and export office at 50 Church St. has been announced by H. K. Porter Co., Inc., Pittsburgh, Pa. The new office will serve as an Eastern center for the company's line of locomotives, process equipment and pumps.

Thomas MacLachlan has been named general manager, and is also handling locomotive sales and service for the entire Eastern seaboard. Mr. MacLachlan was formerly New York manager of Vulcan Iron Works of Wilkes Barre, Pa., a position he had held since shortly after the close of World War I, in which he served as a first lieutenant, Infantry.

R. G. Newell, who managed the New York office of Quimby Pump Co. before its acquisition by Porter, is directing Porter's Quimby Pump Division in New England and the New York district from the new office. Additional district and regional offices are being established.

JOHN W. HUMPHREY has been appointed assistant to General Supt. A. C. Cummins of Carnegie-Illinois Steel Corporation's Youngstown, Ohio, plants. Humphrey, formerly superintendent of the Carnegie-Illinois works at Vandergrift, Pa., is succeeded there by Arno L. Billeter, who was assistant to the general superintendent of the Irwin, Pa., works.

ROGER C. BASCOM has joined the technical service staff of the Hycar Chemical Co., Akron, Ohio, and will leave for the


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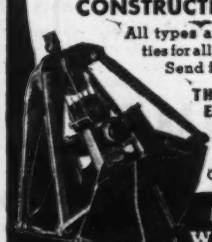

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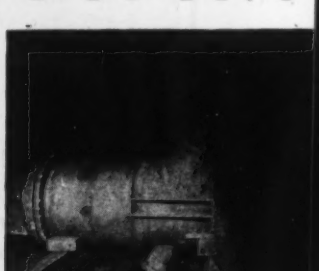

44 in. Special Tee

Large O.D. pipe, special tees, elbows, etc., fabricated from Class A steel, alloy steel or wrought iron, either to your designs or our standards.

Consult Lancaster's experienced engineers when you have a problem in fabricated steel plate work. Complete estimates will be submitted without obligation to you.

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...atter how handsome it is when erected, the ...y of ornamental iron or steel work is com...ively short-lived unless properly protected ...st rust. Money-wise builders and owners ... learned from experience that the longest ...g, most economical rust protection, dollar for ...r, is HOT DIP GALVANIZING! No other ...od of rust-proofing gives so much value for so ... cost. If you want to be sure of the permanent ...y or usefulness of the iron or steel articles you ... be sure to specify "*Hot Dip Galvanizing.*" If ...make articles of iron or steel, be sure of getting ...uine and expert job of *Hot Dip Galvanizing* by ...ing your materials to one of the members ...d at the right. American Hot Dip Galvanizers ...ciation, Inc., First National Bank Bldg., ...burgh 22, Pennsylvania.

CASE HISTORY—Hot Dip Galvanized *balcony railings erected on this San Francisco apartment in 1919 are still in perfect condition, while black channel iron supporting balcony is badly rusted, causing the concrete to crumble away.*

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...ot just Galvanizing but **hot-dip GALVANIZING**

# 2 Airport PAVING JOBS COMPLETED IN 1943 — Another Started

## With This H&B PORTABLE *Asphalt Plant*

The portable asphalt plant shown above—one of four H & B plants owned by Allegheny Asphalt Paving Company of Pittsburgh—completed two airport jobs in 1943, and started on another. Total asphalt production on the two jobs was 87,600 tons, with an all-time average of 96 tons per hour, and the high production 132 tons per hour. The Allegheny Company's other portable plant—a smaller unit used as an auxiliary plant—completed one airport job in 1943 and started on another. Allegheny Company officials attribute these production records to the efficiency of the double driers, which permitted continuous operation. For many weeks the plants operated a total of 20 hours per day. Literature on H & B portable and stationary asphalt plants will be sent on request.

*The* **FLUIDOMETER**
**AUTOMATIC METERING SYSTEM**
Saves time, materials—insures uniformity. For all types of plants.

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*Hetherington & Berner*


New England and New York territory. Bascom was chief chemist for Standard Products Co. of Post Clinton, Ohio, before taking his new post. He will make his home and headquarters in Milford, Conn.

W. F. Rockwell, president of Pittsburgh Equitable Meter Co., and Merco Nordstrom Valve Co., has resigned as Director of Production for the U. S. Maritime Commission so that he can give his full time to the manufacturing details of war work being done by the several concerns in which he is interested. This has become especially imperative, Colonel Rockwell says, on account of the recent death of Walter H. Parker, vice president in charge of manufacturing. "But," he added, "my resignation to Admiral Land, chairman of the Maritime Commission, was submitted only when it became apparent that the shipbuilding program was 'over the hump'."

Blackstone Studios

Howard L. Stilley, veteran employee of R. G. LeTourneau, Inc., Peoria, Ill., has been promoted to chief field engineer, succeeding Ken F. Park, who resigned to join the Caterpillar Tractor Co. Mr. Stilley, who studied at Chicago Technical college, joined LeTourneau in 1936 after spending six years with the Illinois state highway division. In 1937, when the LeTourneau field engineering department was organized with Mr. Park as chief, Mr. Stilley became his assistant. In February, 1940, Mr. Stilley was made assistant We

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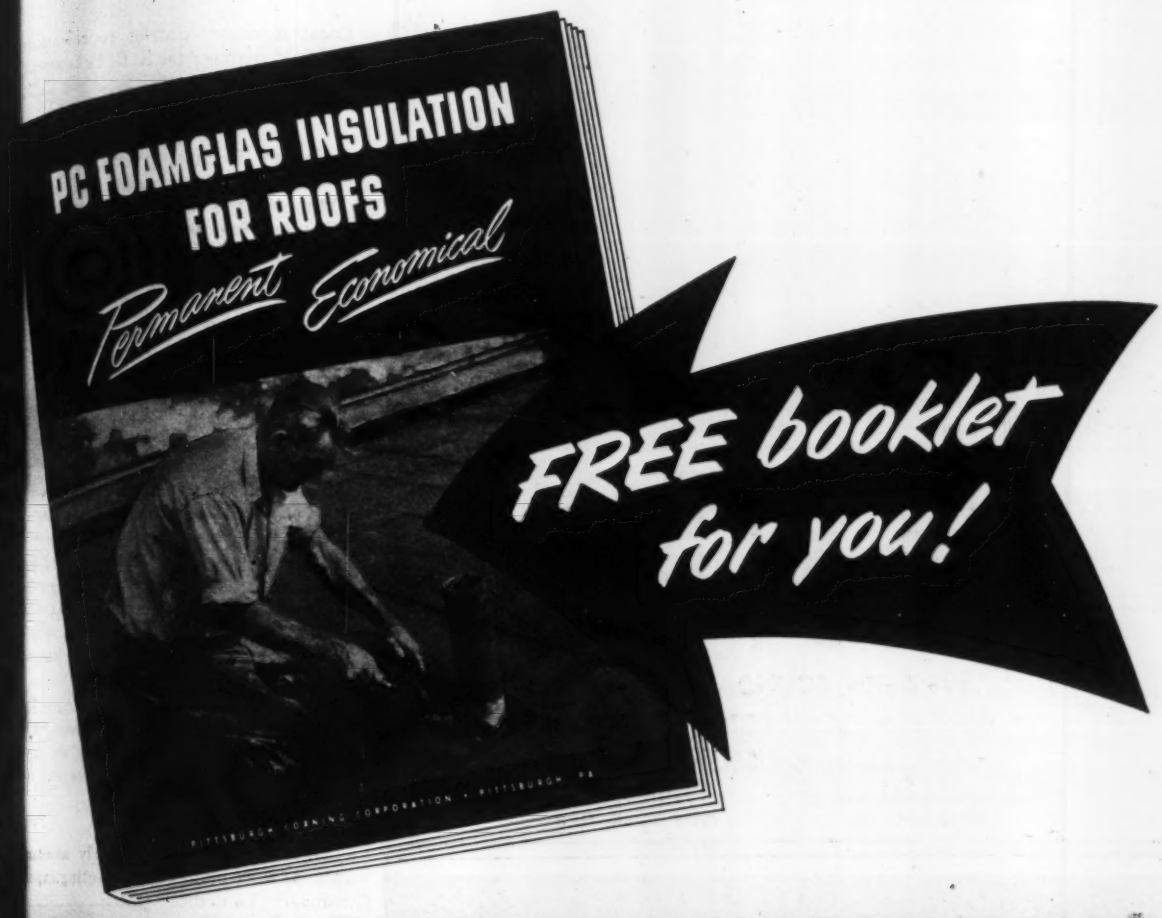


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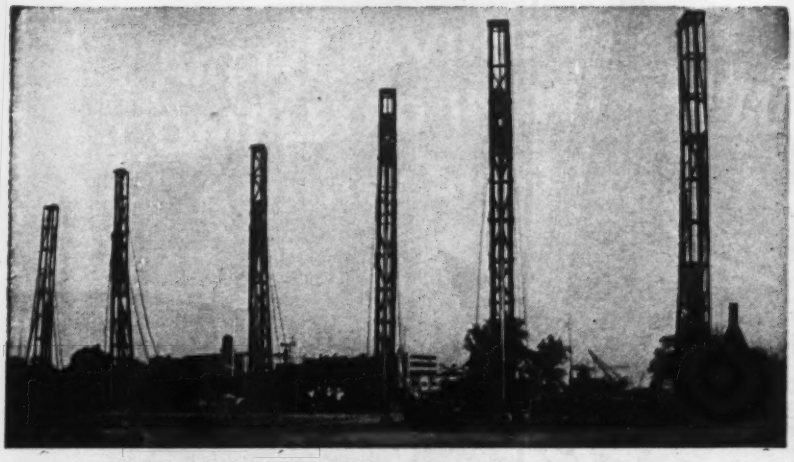

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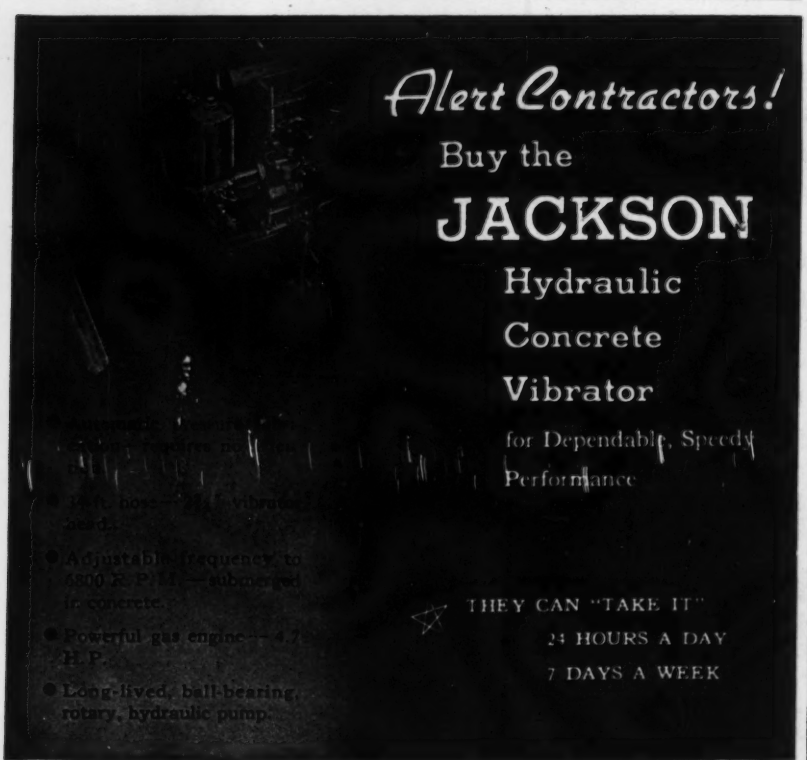


ELECTRIC TAMPER & EQUIPMENT CO.
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Coast manager, district representative and field engineer for R. G. LeTourneau, Inc., with offices at the Stockton, Calif., headquarters.

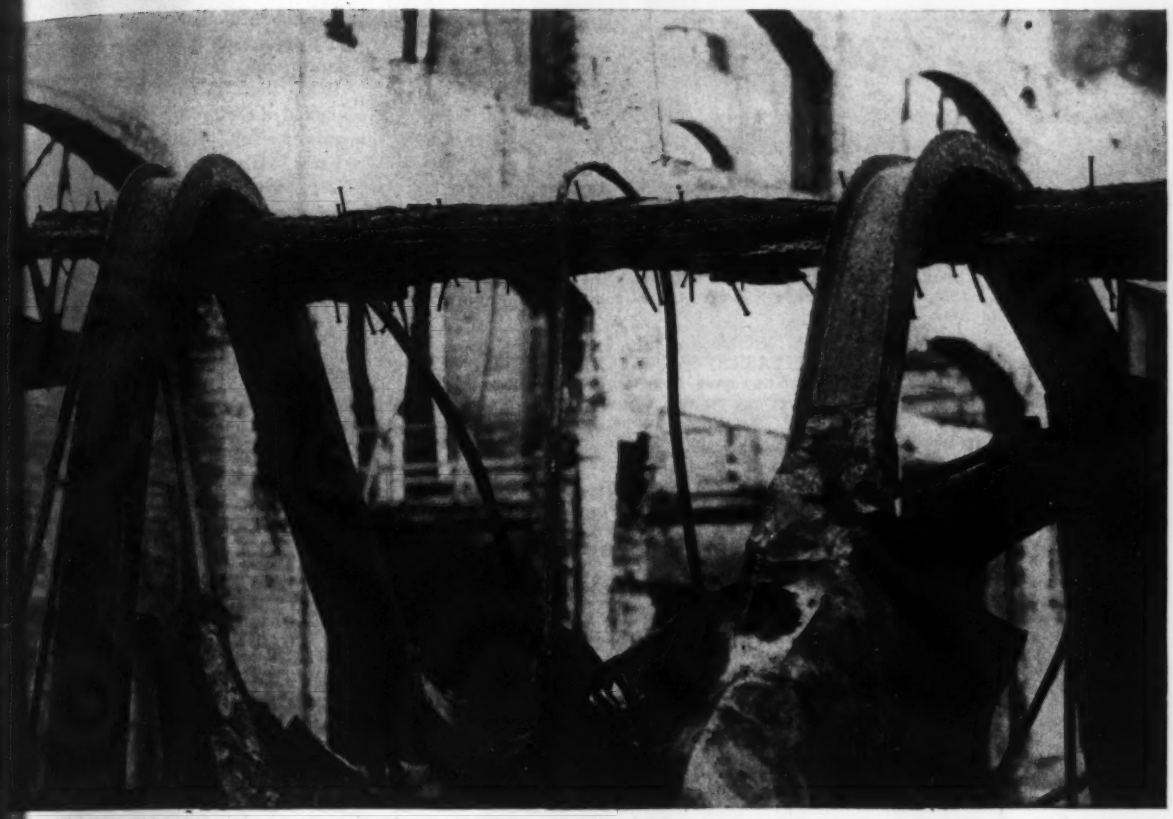
HARVEY T. HILL, recently appointed executive director of the Diesel Engine Manufacturers Association, has announced that the headquarters of the organization will be located in Chicago at One North LaSalle St.

MR. HILL in 1916 became associated with the Chicago Association of Commerce. He was then elected secretary of the Illinois State Chamber of Commerce. Later he became executive vice president of the Chicago Stock Exchange. For the past several years he has been secretary-manager of the Chicago Association of Credit Men, which position he recently resigned to become executive director of DEMA.

Mr. Hill was graduated from the Engineering School of Pennsylvania State College and later received a master's degree in the School of Commerce at the University of Chicago.

H. H. BUCHANAN, formerly assistant general sales manager and acting export manager for the Thew Shovel Co., Lorain, Ohio, has been appointed general sales manager of LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa, manufacturers of earthmoving and land clearing equipment for Caterpillar-built tractors. He succeeds H. N. Graves, who resigned last June.

Mr. Buchanan—or "Buck," as he is more familiarly known by his many friends in the construction equipment industry—began his administrative career as a sales representative for Bucyrus-Erie Co. in 1923. In 1928 he was promoted to district sales manager in charge of the St. Louis office, and three years later was made assistant general sales manager with headquarters in Chicago. In 1936 he joined the Caterpillar Tractor Co. as a special representative. In 1939 he became western district sales manager for the Thew-Lorain. He also served as western sales manager and Washington, D. C., manager before being advanced to the position he held prior to his appointment with LaPlant-Choate.



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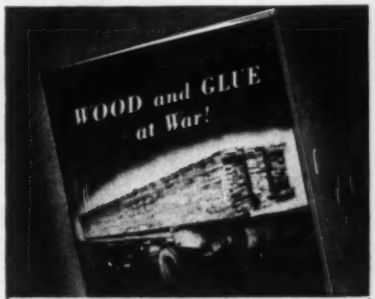


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These time-saving, trouble-saving pile shoes are preferred by America's war-busy construction firms, railroads and on Federal and State projects. SPEED UP *YOUR* PILE-DRIVING JOBS by simply specifying American All-Steel Pile Shoes.

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3 *Sides are made of two sturdy ¼" steel shapes.*

4 *Shoe is assembled by careful welding with coated wire.*

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GEORGE W. HINDS, purchasing agent of the Lamson & Sessions Co. of Cleveland, Ohio, since 1926, has been named director of purchases, and Frank DeCrane has been made purchasing agent.

Hinds and DeCrane have worked together in the Lamson organization's purchasing department for 18 years. Prior to consolidations of other bolt and nut companies with the Lamson and Sessions Co. in 1926 and 1930, Mr. Hinds started as purchasing agent at the Falls River Plant at Kent, Ohio, in 1916. Mr. DeCrane started working as an office boy in 1920 in the old bolt works on Scranton Road, headquarters of the company in Cleveland since 1869. Both purchasing executives have seen sales grow from $9,000,000 to $25,000,000 annually.

WILLIAM R. NORTHLICH, of the Washington, D. C., office of Owens-Corning Fiberglas Corp., has been transferred to the general offices in Toledo, Ohio, as assistant to the general sales manager.

Mr. Northlich joined the U. S. Gypsum Co. following his graduation from the University of Illinois in 1927. Other business affiliations included Celotex Corp., and one of the Weyerhaeuser companies. Prior to joining the Fiberglas Corp., Mr. Northlich was associated with the Buchen Co., Chicago advertising agency, as an account executive assigned to several durable goods accounts.

Joining Owens-Corning in January 1942, Mr. Northlich was a member of the general sales staff for four months.

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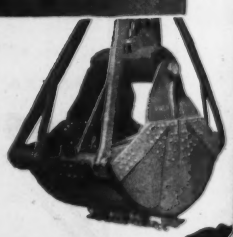
Through demonstrated dependability servicemen have come to place implicit confidence in the ever faithful and efficient American Red Cross.

Through long demonstrated performance, too, bucket users have come to depend with confidence upon Owen Buckets as the most rugged and dependable units available to meet their various important requirements.



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Won't show perspiration stains nor pick up moisture marks
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Harder pencils give solid, opaque lines—less smudge
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Much waste due to accidents—errors—spoilage—loss of time and manpower—can be reduced or eliminated by better seeing. And a new aid to lighting systems is available—Light-Reflecting Floors made with Atlas White portland cement instead of with normal gray portland cement.

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Light-Reflecting Floors made with white instead of gray cement fit into modernization and conversion programs as well as new structures. An interesting book, "Light From Floors," tells the entire story of development, testing, use and cost. For your copy, write to Atlas White Bureau, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, New York.

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Experience shows white-cement floors are easy to clean, easy to keep clean, and retain their reflection advantage. Maintenance is simple—frequent sweeping, occasional damp mopping, periodic scrubbing.

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**Concrete Gun**—A wide variety of uses for concrete guns is described in a new bulletin—among them, the following: Protecting, building, waterproofing, renovating, fireproofing, preserving, coating, mining, reclaiming, repairing, encasing, recoating, insulating, sealing. —*Construction Machinery Co., Waterloo, Ia.*

**Electrical Distribution Systems**—A 36-page bulletin on ducts for electrical distribution systems includes a complete description and application data, price information and illustrations.—*Square D Co., 6060 Rivard St., Detroit 11, Mich.*

**Malleable Iron Valves**—Now available is a six-page brochure describing a new line of Air Furnace Malleable Iron gate, globe, angle and check valves recommended for 150 lb. steam pressure at 450 deg. F., where severe service conditions are encountered.—*Jenkins Bros., 80 White St., New York 13, N. Y.*

**Sewage Pumps**—A bulletin covers all dry-pit sewage pumps of this manufacturer, for municipal and industrial use. It presents in one 32-page book all data, description and detail on the extensive line. It includes new selection tables, new installation drawings and photographs, and up-to-date specifications.—*Yeomans Brothers Co., 1433 Dayton St., Chicago, Ill.*

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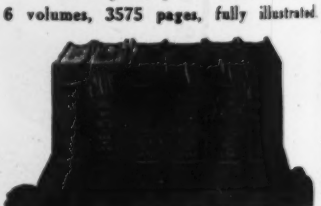

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available. The line includes three sizes of lift trucks, a mobile crane of up to 10,000 lb. capacity, and straddle trucks built in three different models, with several sizes for various package dimensions available in each.—*The Willamette Hyster Co., Portland 8, Ore. or Peoria 1, Ill.*

**Fire Clay Products**—A bulletin introduces three new fire clay brick products. These new refractories, the broadside explains, are designed to supply the demand for fire clay bricks possessing greater spalling resistance, greater load-bearing strength and greater stability. All three brands are made from specially selected Missouri flint clays, moulded with considerably higher than usual pressures and are burned from oversized green bricks at extremely high temperatures to shrink the shape completely to the desired size. Complete information regarding available sizes and exact applications is included.—*McLeod & Henry Co., Inc., Troy, N. Y.*

**Large Synchronous Motors**—Colorful, 4-page literature illustrates motor construction and engineering design. Motors are available beginning with minimum ratings of approximately 300 horsepower, speed 500 rpm., and higher, and are of the coupled, pedestal-bearing type. Synchronous motor control is discussed with illustrations. *Electric Machinery Mfg. Co., Minneapolis 13, Minn.*

**Digging and Rehandling Buckets**—An illustrated vest-pocket publication is for the operating man who wants a quick picture of the improved types of buckets now available, the uses for which each is recommended, the capacities and sizes obtainable. Information and data are given on rehandling and digging clam shell buckets, electric motor buckets, standard and multi-power orange peel buckets, sewer catch basin buckets and automatic take-up reels and grapples for a wide variety of materials such as tiered wood, manure, rocks, tree trunks and pulp wood.—*The Hayward Co., 50 Church St., New York, N. Y.*

**Bitumen and Aggregates**—An illustrated booklet shows how by using this manufacturer's product bituminous work can go forward in any weather, and how emergency work can be done in extreme cold or heavy rain. It is claimed that this product is not affected by water in or on the aggregate, during the mixing, when laying or after it is laid. This means something to both the operator and the taxpayer.—*Koppers Co., 52 Vanderbilt Ave., New York 17, N. Y.*

## MEETINGS

National Conference on Postwar Housing, Drake Hotel, Chicago, Ill., Mar. 8-10.

American Railway Engineering Association, 44th annual meeting, Palmer House, Chicago, March 14-16.

American Wood Preservers Association, annual meeting, Palmer House, Chicago, Ill., April 26.

### Regional and Local Meetings

Arkansas Engineering Society, annual meeting, Marion Hotel, Little Rock, Ark., Feb. 25-26. Minnesota Section, A.W.W.A., St. Paul, Minn., March 13-17.

The New Jersey Mosquito Extermination Association, the Hotel Madison, Atlantic City, New Jersey, March 15, 16 and 17.

New Jersey Sewage Works Association, 29th annual meeting, Stacy-Trent Hotel, Trenton, N. J., March 23-24.

Midwest Power Conference, Palmer House, Chicago, Ill., April 13-14.

New England Sewage Works Association, spring meeting, Hotel Kimball, Springfield, Mass., May 17.

## Elections and Activities

David W. Godat of New Orleans, La., is the new president of the American Society of Civil Engineers, Louisiana section. He succeeds A. M. Fromherz. Other officers are: C. G. Cappel, first


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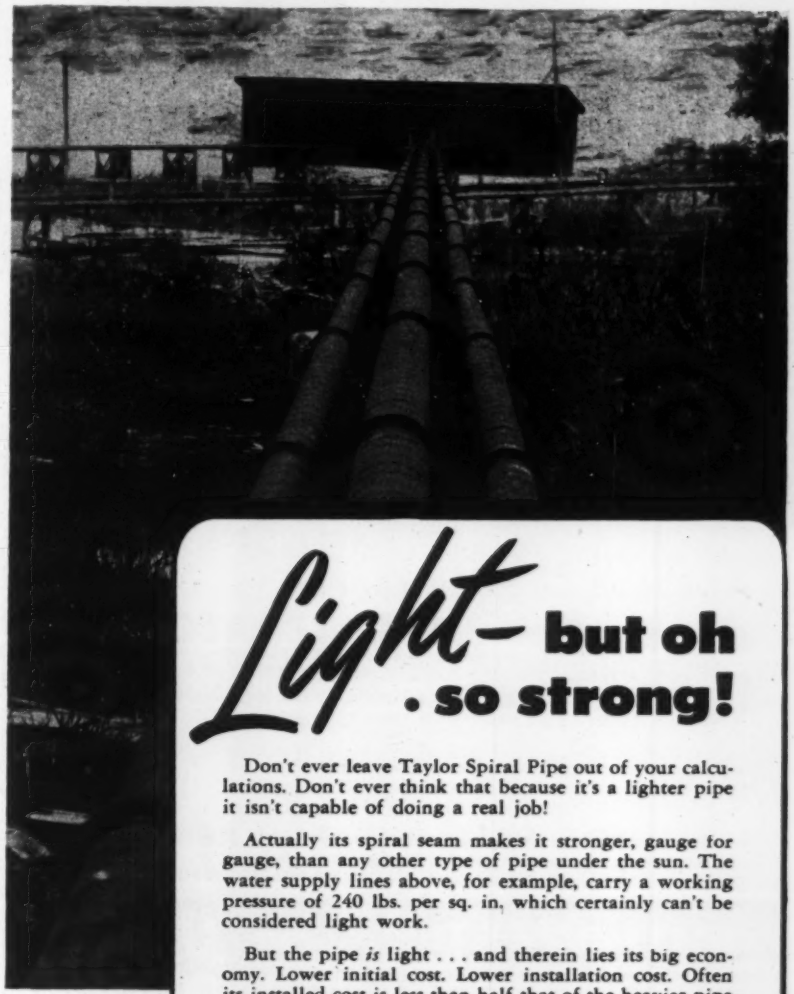

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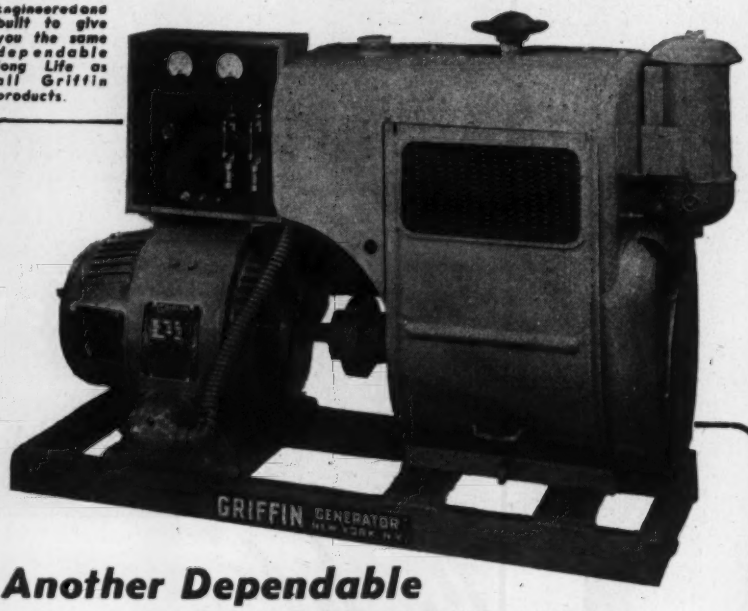


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vice president; Leo M. Odom, second vice president, and E. L. Mire, secretary-treasurer.

The Idaho Association of General Contractors has elected Paul Vernon of Boise as president, with J. W. Terteling of Boise as vice-president and L. D. Robbins, Boise, secretary-treasurer. New directors are Ernest White, Twin Falls; J. R. Brennan, Pocatello, and W. C. Burns, Idaho Falls.

H. C. Nicholls of Toronto has been elected president of the Canadian Construction Association. He succeeds J. B. Stirling of Montreal.

Harry C. Anderson of Vancouver, B. C., has been elected president of the Association of Professional Engineers of British Columbia.

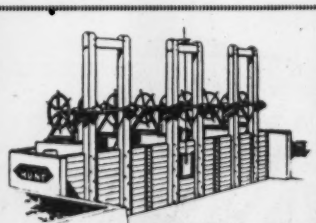
G. P. Wilbur, Ontario Manager of Dominion Bridge Co., Ltd., of Montreal, was elected president of the Toronto Builders Exchange at the annual meeting recently. He succeeds H. P. Nicholls, the only man to have held the presidential office for two successive years, to whom great tributes were paid at the meeting.

Tullis N. Carter, of Carter-Halls-Aldinger, leading Canadian general contractors with offices in Winnipeg and Toronto, has been elected president of the Ontario General Contractors Association.

W. L. Saunders, divisional engineer at Ottawa of the Ontario Department of Highways, has been elected chairman of the Ottawa Branch of the Engineering Institute of Canada.

Godfrey Swenson, head of the Swenson Construction Co., has been elected president of the Kansas City branch of the Associated General Contractors for 1944, to succeed J. E. Dunn.

Named as vice-president was Roy T. Collins, and Carl T. Staunch was elected treasurer.



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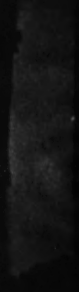
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